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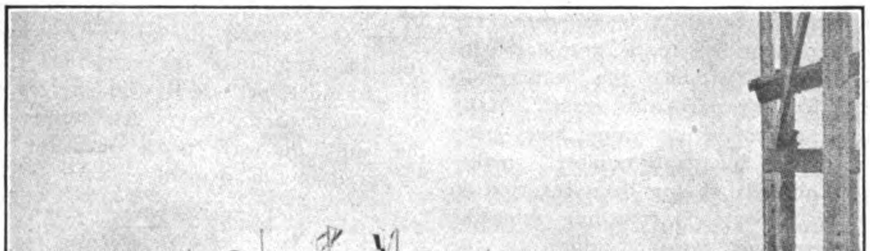
The Sea Performances of the S. S. Monitoria

By Arthur H. Haver, A. M. I. N. A.,

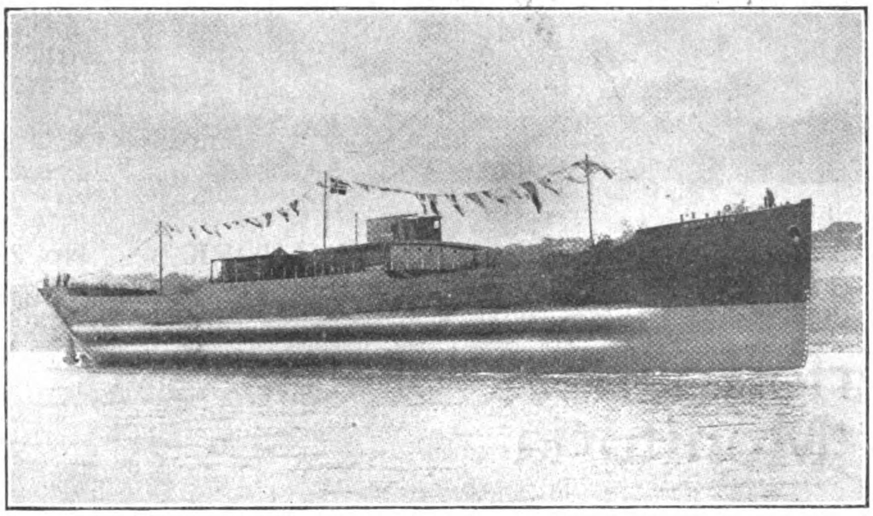
IT is a remarkable fact that, while the inside and above-water portions of the steamship have, during the past forty years, been in a continuous state of re-adjustment, in order to conform with the ideas of various inventors as to strength, tonnage, or the working of cargo, the outside form of the vessel has, during the same period, undergone but little modification. The recent sea trials of the steamer Monitoria, and the principles involved in the construction of that vessel, have, therefore, been of more than usual interest, and have disclosed the operation of a law hitherto ignored in arriving at the resistance of ships. We have in the past been content to consider the relationship of length to speed; and we have had treatises on the effect of vertical frame sections at the ends or full form of midship section, and on the results obtained from broad and shallow ships compared with other forms; but, broadly speaking, we have not gone further than to vary the form of the ends of a hull having the necessary coefficient of fineness and length to obtain the speed and carry the weight, and a contour sufficiently pleasing to the eye. The vessels thus produced have in many cases shown great difference in resistance, and their seagoing qualities have varied, without any apparent reason, forcing us to the conclusion that our existing state of knowledge of the resistance of ships is far from satisfactory or complete.



Launch of the Monitoria—View of After End.

The writer, therefore, has been not a little surprised at the apparent scepticism with which any suggested modification in the form of hull has been received. This is doubtless due in no small measure to the belief that a ship, irrespective of form, will require a propulsive horse power directly proportionate to the wetted area. This, however, is not always so, although it may be very nearly correct in ordi-

nary ship-shaped forms, and its very nearness may possibly have led to its acceptance as a proved law. It is only after a vessel having increased wetted area shows less resistance (as proved on the trials of the Monitoria) that progress through the water are peculiar to that vessel; and in introducing corrugations they must of necessity be adjusted in size and proportion to suit certain laws if the full benefit of their application is to be secured.



THE MONITORIA IMMEDIATELY AFTER LAUNCHING; BROADSIDE VIEW.

we begin to question the finality of the generally accepted law, or at all events to seek for an explanation or amplification of it.

The Monitoria is in most respects an ordinary single-deck cargo steamer, with poop, bridge, and forecastle, built by Messrs. Osbourne, Graham & Co., of Hylton, Sunderland, to the order of the Ericsson Shipping Co., Ltd., of Newcastle-on-Tyne. She is 288 ft. 6 in. over all and 279 ft. 6 in. B. P., by 39 ft. 10½ in. in breadth molded, by 20 ft. 7½ in. depth molded. Instead of the usual wall-sided shell plating, however, the vessel has two longitudinal corrugations, in the form of rather flat arcs, along the outside of the hull, so that where these are added the breadth of the ship is increased to 42 ft. at the widest part. These two wavelike swellings, which are shown in our illustrations, extend along both sides of the hull below the load water line to about the turn of the bows and quarters, where they gradually merge into the ordinary contour of the ship's lines at the ends.

Sympathy Between Stream Lines and Corrugations.

It has been unmistakably demonstrated that there is great sympathy between the stream lines round the vessel and these corrugations, varying proportions giving varying results. As the co-efficient of fineness and the contour of sections and lines nearly always vary in different ships, the stream lines created by any vessel's Accordingly, any attempt to design corrugations in a haphazard, approximate fashion, without any regard to the forces involved, may or may not result in a satisfactory improvement; and it is precisely this aspect of the problem that has to be grappled with in order to produce the best conditions for any particular vessel. Many inventions of great value have been discredited by approximate, makeshift methods having been resorted to during trials, thus retarding scientific progress and causing injury to the advocates of new ideas. This possibility was disclosed, in the course of the experimental work extending over several years, by the failure or reduced advantages in some cases and the great success in others, clearly indicating that law and science were associated with the corrugated-side principle.

The corrugations, naturally, give more buoyancy to the vessel, increase the periphery of shell plating girth, and therefore augment the wetted frictional area. These conditions, of course must be considered prejudicial to speed if taken alone without any gain from other sources. The tank experiments, however, showed an improvement, more or less according to some hitherto undiscovered law; and when the corrugations were properly adjusted to suit a particular vessel, improvement could be relied upon. The tests were conducted in the experimental tank invented by the late Frank Caws, of Sunderland. The writer is aware that this tank has been the subject of much criticism, but his knowledge of it extends over about twelve years; and as he has been the exclusive operator since the inventor's death, the writer can only express admiration for its general scheme and reliability. For comparative purposes it is, in his opinion, an ideal instrument for testing the resistance of ships; while the fact that the results obtained during the model experiments in connection with the Monitoria have been confirmed in the actual ship, proves that the tank used is at least as reliable as any of the larger speed tanks in existence.

Diminished Bow and Stern Waves.

Throughout the experiments were always accompanied by a diminished height of bow and stern wave, which appeared to point to the principle that the higher the disturbance the greater the resistance. Bluff ships, of course, gave a higher bow wave and absorbed more power, and it was also apparent that the fuller ships permitted a greater percentage of improvement than fine-lined vessels. A wave of given length may have a height indefinitely large or small, according to the power exerted to create the wave; but if a certain horsepower is exerted to create a wave and the amplitude is restricted, the length must necessarily be increased to absorb the power. As, however, the length of wave is the measure of its speed in the ratio of

$$\sqrt{\frac{\text{Length of wave}}{0.557}}$$

a greater speed of wave is obtained with the same energy contained in that wave. This augments the speed of the water passing the vessel, causing less retardation and eddy than before; while the bow wave is also prevented from attaining the height it would if the water further aft were retarded. This in turn favorably affects all the other froces acting round the vessel, and indeed in the tank experiments it was a very common occurrence to obtain a reduced resistance equal to 10 per cent. (and in some cases over 18 per cent) of the engine power and coal consumption.

A Subject But Partially Known.

The action of water, waves, and ship resistance generally, as already indicated, are only partially known. The subject is a very complex one, with few facts for a definite basis and much scope for generalities; and there is still much to discover by those who have studied the subject. The general principle of robbing the

vertical power of the waves to pay for the horizontal propulsion of the vessel is exemplified in a variety of ways. For instance, the most speedy horse is not the one given to vertical or lateral action. A man who has a pronounced lift and fall at each step is not the quickest walker, neither is the man with a pronounced lateral roll. Again, an express train could not be expected to make a record if the track were a series of vertical or lateral irregularities.

The Monitoria has proved that the peculiar corrugations along her sides are really effective in principle, size, and proportion, to reduce the wave irregularities and so admit of more power being available for horizontal propulsion, for in every respect the experimental tank results have been confirmed in practice. With the vessel herself the waves have been prevented from attaining their free amplitude, and the surface of the water round her has been seen to be smooth and transparent, while beyond the ship and parallel with her the water has been white with foam. The action of the corrugations has reduced the period of roll, making a more steady and comfortable sea-boat; and—what is perhaps more important, the longitudinal pitching and scending have also by the same law been reduced, which means that the undulating waves towards the ends have been partially crushed by the corrugations and made to reappear further aft, instead of bursting upon the bow and leaping freely to the deck, as with vessels of the usual form.

The commander of the vessel, Captain George Dobson, reports as follows: "The effect of the corrugations upon the steering qualities is very beneficial, with no sheering to windward in a seaway. The wake of the vessel, instead of being the full width, is only about half the width of the vessel, the same being smooth and clear, with no wave-following motion. In a diagonal sea running 9 to 10 feet high, her speed was safe at 7¼ to 7½ knots; whereas had a ship of ordinary form encountered this sea, her speed would have been down to 6 to 6½ knots, according to my experience." The slip of the propeller, it may be added, is considerably reduced, although no alteration was made in the design of the propeller from that adopted for the sister vessels.

No Extra Weight.

The weight of a ship constructed on the Monitor principle need not be any heavier than one built to the ordinary design, as the addition to the weight involved by the extra periphery of shell is balanced by the entire absence of hold stringers and increased frame spacing; while the extra buoyancy obtained admits of about 3 per cent more cargo being carried. This extra displacement can be propelled through the water more economically than the smaller displacement of a ship of normal shape. In the Monitoria the extra speed at 10 knots was 5 per cent, and at 9 knots 4.23 per cent, using the same engine power as adopted in all the sister vessels. The speed was attained with the engines making only 58 revolutions instead of the usual 62, a saving of 4 revolutions per minute. It should be borne in mind that an easier propelled vessel has a greater radius of action owing to the reduced quality of coal required. There is no increase in tonnage, so that the dues remain unaltered. A Monitor ship is stronger in resisting strains which tend to crush in the sides, stronger in resisting hogging and sagging strains, and stronger laterally.

In conclusion, the advantages claimed for a vessel constructed on the corrugated—side principle—less resistance, less horse-power, less coal consumption, and increased strength—are further enhanced by the fact that the ship rolls and pitches less readily. The latter feature, it need not be pointed out, is of great value in a battleship or cruiser, where a steady gun platform is of first importance. In a passenger vessel, the addition under consideration would add to the stiffness, prevent vibration, reduce rolling, and increase the speed. These benefits are all secured in conjunction with the gain in carrying power, whether used for freight, passengers, or men and fighting material. It is not too much to say, therefore, that the economy of any type of vessel, whatever its advantages accruing from skillful design and arrangement of material, can be still further increased by the application of the Monitor corrugations to the sides of the hull; and the day is not far distant when this will be demonstrated in a first-class liner as well as in a cruiser for a foreign navy.—*The Ship Builder.*

NEW STEAMER FOR CANADIAN SERVICE.

An important addition has been made to the fleet of the Cairn Line of Steamships, Ltd., of Newcastle and Dundee, for their Canadian service, in the twin screw steamer Tortona, which is being built by Messrs. Swan, Hunter & Wigham Richardson, Ltd., at their Wallsend ship yard.

This vessel, which was launched Aug. 18, is a finely modeled, four-masted twin-screw steamer, with complete shelter deck; 464 ft. over all length; 54 ft. 2½ in. beam and 40 ft. deep to the shelter deck, and has a gross tonnage of about 7,600. She has been built to the highest class at Lloyds, and to the regulations of the British board of trade, American and Italian emigration laws, and has accommodation for 37 first class and 1,082 third class passengers. The first class passengers are accommodated in large staterooms on the bridge and shelter decks. The first class dining saloon is amidships on the shelter deck, and a tastefully arranged ladies' room, and smoke room are built at the fore end of the bridge, with access from the entrance house. The forward and after portions of the shelter 'tween decks and the two after compartments of the main 'tween deck form the third class sleeping quarters There are three third class dining rooms placed amidships under the shelter deck. To provide easy access to the third class accommodation a specially large number of ladders and emergency ladders have been provided, the space at the foot of each being kept free.

In order to cope with the requirements of the numerous passengers, the cooking arrangements have received special consideration. There are two kitchens, one forward and one aft for the third class passengers, and there is another large kitchen for the first class passengers and officers. All the kitchens have a complete installation of steam boilers, ovens, grilles and cooking ranges. The bakery is in the shelter decks and is fully equipped with ovens and dough mixers. For the perishable stores there are insulated cool rooms.

The main hospitals for men and women are at the after end of the bridge, and comprise an operating room and dispensary, together with room for the hospital attendants and nurses. The infectious diseases hospitals are in a separate deck house aft completely isolated from the cabin accommodations. The sanitary arrangements and baths throughout the ship are very complete to comply with the British, American and Italian laws.

The captain's apartments are on the navigating bridge, and underneath are the cabins for the officers and engineers. The ship will also carry a doctor, purser, chief steward, stewardess, matrons, an Italian emigrants' commissioner, a chef and 58 stewards, bakers and storekeepers. These, together with the deck hands and engine room staff, make a crew of 140 persons.

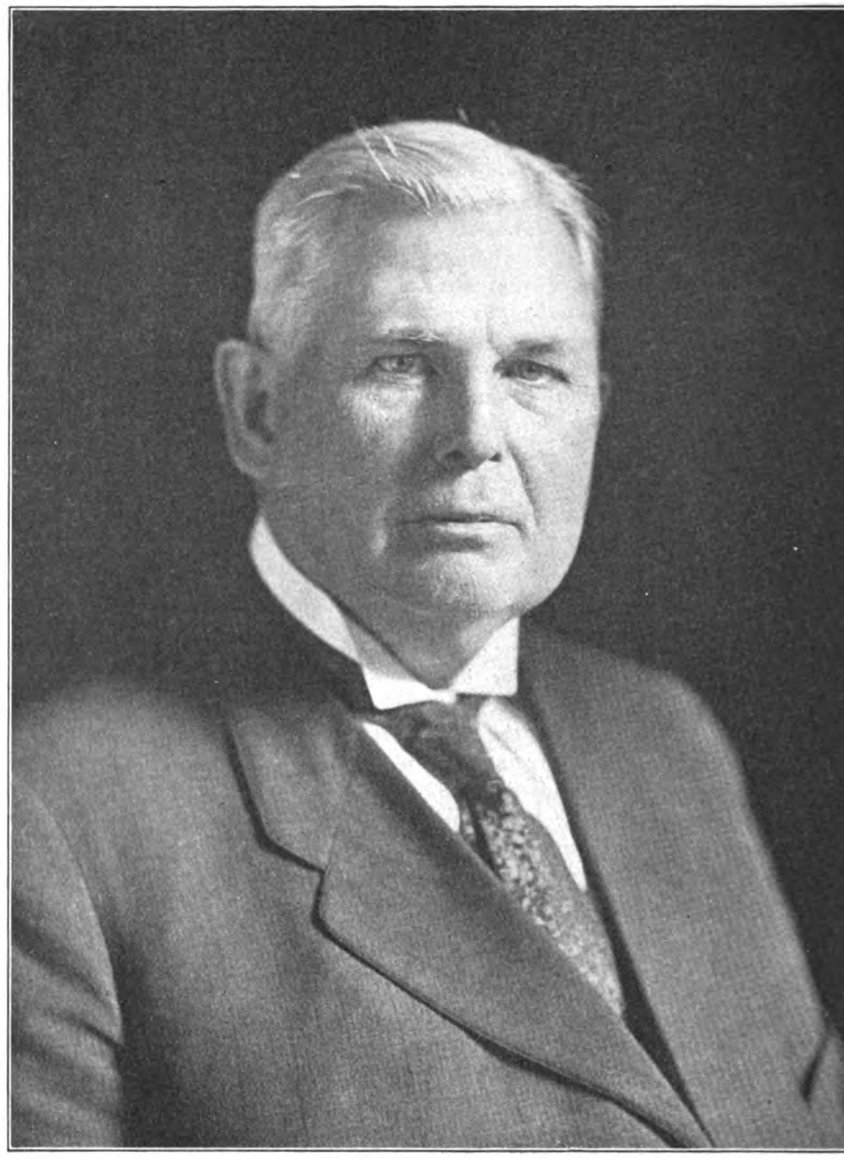
Naval Architects and Marine Engineers

THE seventeenth annual meeting of the Society of Naval Architects and Marine Engineers was held in the rooms of the society, Engineering Societies Building, 29 West Thirty-ninth street New York, on Nov. 18 and 19, and was in point of interest and attendance the equal of any that has been held in recent years. In the absence abroad of President F. T. Bowles, Stevenson Taylor presided. The report of Secretary-Treasurer W. J. Baxter snowed the society to be in excellent financial standing, though its expenditures owing to the summer meeting had been unusually heavy. The society has total resources of $24,575.21 with no liabilities. An interesting point in the society's financial statement is that receipts from the sale of its publications amounted to $1,092.80 from non-members, proving conclusively that the proceedings of the society are appreciated even by those who are not members. The membership shows a gain of 30 during the year, the membership as of Nov. 1, 1909, being 795, as against 765 for the corresponding date last year.

At the suggestion of Chairman Taylor, the members rose while the death roll was read as follows:

F. S. Manton,
Thomas Gray,
W. E. Hill,
W. F. Palmer,
H. Wilkinson,
J. B. L. F. M. Berrier-Fontaine.

The council elected the following:



MR. STEVENSON TAYLOR, PRESIDENT-ELECT SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS.

Vice-presidents:

Jacob W. Miller, vice-president, Cape Cod Canal Construction Co., 23 Nassau street, New York.

George W. Melville, Rear Admiral, United States Navy, retired, 532 Walnut street, Philadelphia, Pa.

The society elected as members to the council the following:

For term expiring December 31, 1912:

William J. Baxter, Naval Constructor, U. S. N., navy yard, New York.

George W. Dickie, Naval Architect and engineer, 24 California street, San Francisco, Cal.

W. D. Forbes, president, W. D. Forbes Co., New London, Conn.

Andrew Fletcher, president, North River Iron Works, Hoboken, N. J.

Henry A. Magoun, vice-president, New York Shipbuilding Co., Camden, N. J.

Lewis Nixon, No. 30 Church street, N. Y.

Associate Members of Council:

For term expiring December 31, 1912:

John S. Hyde, President, Bath Iron Works, Bath, Me.

Calvin B. Orcutt, President, Newport News Shipbuilding & Dry Dock Co., 30 Church street, New York.

Members.

H. L. Brinser, Lieut. U. S. N., Naval Academy, Annapolis, Md.

Bonne J. Bonnesen, Pusey & Jones Co., Wilmington, Del.

Hutchinson I. Cone, Rear Admiral, U. S. N., chief of the Bureau of Steam Engineering, navy department, Washington, D. C.

Stafford H. B. Doyle, Lieut. U. S. N., Naval Academy, Annapolis, Md.

Irvin W. Day, American Mail Steamship Co., 100 Broadway, N. Y.

William L. R. Emmet, General Electric Co., Schenectady, N. Y.

Irvin V. Gillis, Lieut. Comdr., U. S. N., Navy Department, Washington, D. C.

Charles S. Hoyt, Welin Davit & Lane and De Groot Co., 17 Battery Place, New York.

Charles G. Jewett, Draughtsman, Newport News S. B. & D. D. Co., Newport News, Va.

Carl W. Jungen, General Manager, Southern Pacific S. S. Line, 105 Hudson street, New York.

Ralph L. Lovell, Fore River Shipbuilding Co., Quincy, Mass.

Bernard Mills, American Hawaiian S. S. Co., 369 Eighty-seventh street, Brooklyn, N. Y.

William Macnamara, Chief Constructor, Chilian Government, Talcahuano, Chile.

William J. Marshall, Inspector Machinery (general), Chilian Navy, Chile.

Levin S. Parker, Mechanical Engineer, Atlantic Gulf & Pacific Co., 2405 Park Row Building, New York.

Ernest H. Rigg, Naval Architect, N. Y. Shipbuilding Co., Camden, N. J.

Milton E. Reed, Lieut. Comdr., Head of School of Marine Engineering, Naval Academy, Annapolis, Md.

Frederick G. Rogers, Superintendent, Lehigh Valley Transportation Co., L. V. R. R. Depot, Buffalo, N. Y.

William E. Reynolds, Capt. U. S. R. C. S., Superintendent of Construction and Repair, Custom House, Baltimore, Md.

Samuel Murray Robinson, Lieut. U. S. N., School of Marine Engineering, Naval Avademy, Annapolis, Md.

John Reid, naval architect and engineer, 41 Park Row, New York.

James O. Richardson, Lieutenant, U. S. N., Naval Academy, Annapolis, Md.

Walton R. Sexton, Lieutenant, U. S. N., Naval Academy, Annapolis, Md.

Frederick L. Sawyer, Lieut. Comdr., U. S. N., Navy Department, Washington, D. C.

D. Howard Spear, President, Kelly-Spear Co., Bath, Me.

Roger P. Stebbins, Electric Boat Co., Quincy, Mass.

Walter B. Tardy, Lieutenant, U. S. N., Annapolis, Md.

John K. Turnbull, Superintending Engineer, N. Y. & Porto Rico S. S. Co., Pier 35 Atlantic Basin, Brooklyn, N. Y.

John H. Walsh, Assistant Naval Constructor, U. S. N., Navy Yard, Puget Sound, Wash.

Joseph B. Weaver, Assistant Superintendent, Hull Construction, Newport News S. B. & D. D. Co., Newport News, Va.

Theodore D. Wells, Naval Architect and Engineer, 32 Broadway, New York.

Robert A. Workman, Estimator, N. Y. Shipbuilding Co., Camden, N. J.

Lewis Collins, Superintendent, Ocean S. S. Co., Pier 35, N. R., New York.

John J. Brown, Wheeler Condenser & Engineering Co., Carteret, N. J.

George F. Crouch, Webb's Academy, 2511 Sedgwick avenue, Kingsbridge, N. Y.

William J. Davidson, Staten Island Shipbuilding Co., Port Richmond, N. Y.

Alexander McPhee, Lake Torpedo Boat Co., Newport News, Va.

C. Lee Straub, Marine Producer Gas Power Co., 2 Rector street, New York.

Elmer A. Sperry, Consulting Engineer, 40 Wall street, New York.

Theodore D. Wells, Naval Architect and Marine Engineer, 32 Broadway, New York.

Associates.

Albert W. Butler, Shipbuilder, Cobb, Butler & Co., Rockland, Me.

Walter A. Clarke, Computer, Marine Department, Maryland Steel Co., Sparrow's Point, Md.

Victor C. Lasseu, President & Manager, Victor Metals Co., East Braintree, Mass.

S. Inglis Leslie, The Leslie Co., Lyndhurst, N. J.

Joseph D. Thomas, Chief Draughtsman, Pusey & Jones Co., Wilmington, Del.

Harry W. Thorp, Manager, Goodrich Transit Co., Foot of Michigan avenue, Chicago, Ill.

Dimitry Vassilieff, Commander, Russian Navy, Russian Embassy, Washington, D. C.

Frank H. Osborn, Marine Insurance, 134 Monroe street, Chicago, Ill.

Juniors.

Harris R. Bailey, Chief Draughtsman, Whittelsey & Whittelsey, 11 Broadway, New York.

Carl A. Bergstrom, Draughtsman, 22 Edison street, Quincy, Mass.

Carroll T. Berry, 80 Roberts street, Portland, Me.

Wilhelm E. Fermann, Stoughton, Wis.

Heenan T. Shen, Student, Massachusetts Institute of Technology, Boston, Mass.

Lawrence M. Thompson, Hull Draughtsman, Lighthouse Board, Washington, D. C.

Nathaniel A. White, Draughtsman, Manufacturing Department, Navy Yard, Philadelphia.

Charles W. Hubbell, Draughtsman, New York Shipbuilding Co., Camden, N. J.

Associate to Member.

James L. Ackerson, Assistant Naval Constructor, U. S. N., U. S. S. Connecticut, care of Postmaster, New York.

Guy A. Bisset, Naval Constructor, U. S. N., Navy Yard, Norfolk, Va.

William B. Ferguson, Jr., Assistant Naval Constructor, U. S. N., U. S. S. Yankee, care of Naval Station, Newport, R. I.

Frank D. Hall, Assistant Naval Constructor, U. S. N., Navy Yard, Mare Island, Cal.

Harold F. Norton, Chief Draughtsman, Hull Department, Newport News S. B. & D. D. Co., Newport News, Va.

Alexander H. Van Keuren, Assistant Naval Constructor, U. S. N., Navy Yard, Philadelphia.

Isaac I. Yates, Assistant Naval Constructor, U. S. N., Navy Yard, Boston, Mass.

Henry Williams, Naval Constructor, U. S. N., Bureau of Construction and Repair, Navy Department, Washington, D. C.

George H. Bates, Staten Island Shipbuilding Co., Port Richmond, N. Y.

Richard D. Gatewood, Assistant Naval Constructor, Navy Yard, Mare Isl., Cal.

George H. Waters, Waters-Colver Co., West New Brighton, N. Y.

Juniors to Members.

H. H. Brown, Editor, *International Marine Engineering*, 17 Battery Place, New York.

Martin C. Erismann, Draughtsman, Fore River Shipbuilding Co., Quincy, Mass.

Samuel D. McComb, Marine Surveyor and Adjuster, Charles M. Hall Co., 64 Wall street, New York.

Lyman F. Hewins, Leading Ship Draughtsman, Navy Yard, Washington, D. C.

Harry L. Hibbard, Engineer, Cutler-Hammer Mfg. Co., Milwaukee, Wis.

Joseph S. Potter, Assistant Superintendent, Gas Engine & Power Co., and Charles L. Seabury & Co., Morris Heights, New York.

Edwin A. Stevens, Jr., Manager, E. A. Stevens & Co., 1 Newark street, Hoboken, N. J.

H. E. Greishaber, Electric Boat Co., New York.

Address of Stevenson Taylor.

Before proceeding with the regular order of business, Stevenson Taylor, chairman, made a few remarks, saying:

"I am very sorry, indeed, to say that due to the absence abroad, our president, Admiral Bowles, is not with you this morning. I have still hopes that before the meeting is over he will be present. The council was good enough to nominate me for the permanent chairmanship in his absence, which accounts for my presence here now. I am obliged to the council for the honor thus given me,

but between ourselves, I would rather be on the floor, a free lance, than serve you in the chair. I would have more fun, I think, if I were on the floor; but be that as it may, here I am ready, and being called to duty, I respond, as all good soldiers do, and will do the best I can under the circumstances.

"Being only temporary chairman, as it were, I prepared no address as chairman, for, as I have said, I had hopes up to yesterday afternoon that Admiral Bowles would be here to make his own presidential speech, but there are two or three subjects upon which I wish to say a few words, and my remarks will be very brief.

The Detroit Meeting.

"First, I wish to repeat what I said in Detroit last summer. You will remember we had a summer meeting, an extra meeting of this society, at which, I am very sorry to say, there were not near enough members present to appreciate and enjoy the hospitality of our western friends. We had a fine time in every way, and they did all that was possible to make those who were present comfortable and at home in that beautiful city of Detroit. Now, I want to warn you that possibly you may get a chance again to go west to attend an extra meeting of the society. Such a thing has been hinted at—whether it comes this year or next—or when, I know not, but if the occasion does come, I trust all of you will take my word for it that it will be worthy of attention by each and every one of you, and I trust that you will all be there.

"Those of you who were fortunate enough to see the naval parade at the opening of the late Hudson-Fulton celebration in this city—and those of you who were not fortunate enough to see it must have seen pictures of it and illustrations of all sorts, verbal and otherwise, must have been greatly delighted at the magnificent display of naval architecture and marine engineering. As you came up that crowded bay, by the river, along that magnificent display of war vessels—war vessels, I have said, but messengers of peace some of us believe—you must have been thrilled with the fact that, with the exception of the foreign vessels that were there anchored, all the vessels in the procession, every vessel of note, was the result of effort in some direction by members of this society. I certainly take great pride in thinking that that was a display worthy of a society of very much greater numbers, but of no more importance, that this society.

But that brings to mind another question—that thrill of joy was a little bit touched by a certain disappointment. As you passed up the river and saw the numberless vessels gaily arrayed in flags celebrating that day, you saw not one vessel flying the American flag, which was engaged in foreign trade. Born as I was in the city of New York, raised on its water front, engaged in and on the water as a boy and man ever since, and old enough to remember the Collins steamers that fortnightly left the foot of Canal street, amid the firing of a gun, a matter of such importance it was for a vessel to go to Europe—remembering all this, proud of the fact that I am a New York citizen, proud of the history of New York, proud of its commercial superiority in every way—there still mains a greater pride, the pride of being a citizen of the United States, under our flag, our stars and stripes.

A More Than Twice Told Tale.

This being so, it is a regret to me to feel that today, if we wish to go to Europe, there are but one or two vessels bearing our flag upon which we can go, that the magnificent steamers, those we each really wish to go on, if we care to go at all, bear a foreign flag. This is not a twice told tale, but has been told over and over again, and has been for years, but still we must stick to this particular question of the American merchant marine, not only as naval architects but as citizens, our duty and patriotic privilege being to enhance the prosperity of our merchant marine. You will notice on the program a paper to be read by Mr. Dickie, of San Francisco. When this paper was submitted to the council I was opposed to its acceptance on the ground that is expressed opinions contrary to the custom of the society, but I am pleased to say that I was overruled and the paper will be read. It treats of political possibilities in regard to the merchant marine. The difficulty of legislation in this matter has been that so many ways have been suggested and the advocates of each are so bitterly opposed to the others that it has been impossible to decide upon one course. The New York Chamber of Commerce has been expressing itself for one policy and our friend, Mr. Nixon, for another. At the dinner of the society tomorrow evening, at which I expect to preside, there will be two or three speakers on this matter and I hope that some way will be set forth in which we can all join for the good of the cause."

At the conclusion of Mr. Taylor's remarks, Secretary Baxter announced that the council by their first ballot had unanimously chosen Stevenson Taylor for the presidency of the society for three years beginning Jan. 1 next. Naval Constructor W. J. Baxter was also chosen secretary and treasurer for the next three years. These nominations were unanimously ratified by the society.

Evolution of Screw Propulsion in the United States

THE society then proceeded to the reading of the papers. The first paper on the program was "The Evolution of Screw Propulsion in the United States," by Charles H. Cramp, vice president. In the absence of Mr. Cramp the paper was read by W. A. Dobson. It was largely historical in character and was admirably abstracted by Mr. Dobson. Though the screw propeller was invented by Col. John Stevens in 1804, its real development did not begin until about 1840 owing to the absence of good machine shops in this country. John Ericsson was the real founder of screw propulsion in this country. He arrived here in 1840 and made the acquaintance of Thomas Clyde, who soon became a convert to screw propulsion and was the first ship owner to adopt it in this country. A pair of screws was fitted to the J. S. McKim, which he used in his gulf trade and later as a transport in the Mexican war. While Ericsson accomplished more in the education of the public mind in the matter of screw propulsion, he was not successful in the introduction of his own screw. The original screw of Col. Stevens was replacing all others, but not under his name. The favorite screw of Reaney, Neafie & Co. was the Loper patent. Capt. Loper had bought the patent from a workingman and probably died without knowing anything of its resemblance to the Stevens propeller. The firm of Sutton, Smith & Co. took a decided stand in building the screw propeller engines and became quite a rival to Reaney, Neafie & Co. They introduced English types with great success. They were of the oscillating and horizontal trunk kind. Great Britain's supremacy in screw propulsion practically began with the screw ship Great Britain, in 1844. Meanwhile New York interests would not

consider any other but the paddle wheel with its walking beam engine, and as they knew nothing of any other type, readily pronounced its superiority over all other types and carried with them the ship owners, ship builders and mariners generally, the screw propeller being sneered at by them as a low down Philadelphia idea. This last argument was a clincher, anything from Philadelphia being regarded the limit of technical depravity.

Iron Construction in the United States.

A short time after iron construction was introduced abroad, certain engine builders began iron construction in the United States. The first one in America was built in Kensington at the boiler works of Jesse Starr, several squares away from the water and was hauled to the water's edge by a large number of horses and then launched. The first iron steamers were fearful specimens of naval architecture. The workmen were the boiler makers of the works and the vessels were looked upon by these engine builders as merely exaggerated boilers. At first they employed commonplace shipwrights to do certain wood work that the vessel needed. Reaney, Neafie & Co. took a somewhat more advanced stand than their neighbors. They usually gave the whole ship building work with its technique to first class ship builders. They made contracts for this work with John Beyerly & Son and with William Cramp. Contracts at this early date were of great advantage to William Cramp and his son, who can justly say that they were in the business of iron ship building with the earliest anywhere.

Many of Reaney, Neafie & Co.'s improved methods in engine work were due to J. Shields Wilson, who had been placed in charge of their drawing room. He had been brought up in the I. P. Morris Works and had gone to Reaney, Neafie & Co. to post himself on screw propulsion and screw devices. He soon appreciated the great defects that existed in all of the works of this country.

During the reading of Mr. Cramp's paper, Mr. Dobson, upon the completion of the paragraph at the top of page 3, closing with "to what was original with them," said: "In this connection it may be of interest if we should go back over the records of the British Society of Architects and there find a paper on the Stevens battery—and our cousins across the water are very modest in claiming things—but if you will look at that design, you will find that in the first application to an armored vessel of twin screws, the protective deck was worked into that design, also the much used balanced rudder, where a portion of the rudder extended under the deadwood, the deadwood being cut away to accommodate it."

Discussion on Mr. Cramp's Paper.

President Taylor: Gentlemen, this paper is now before you for discussion.

Mr. Horace See: Mr. President and Gentlemen, I would like to make a few remarks on the paper. Mr. Cramp's very interesting reminiscences of the evolution of screw propulsion in the United States have carried me back to my early experience and associations, not only with this evolution, but also with those of the metal vessel, where I find a mass of information bearing on both subjects, but as the full presentation of the matter would make a voluminous paper, I shall only use at this time some that somewhat differs from, or enlarges a little upon, what Mr. Cramp has given in his paper; this matter being largely that which came under my personal observation.

John Shields Wilson, to whom Mr. Cramp calls attention, entered the Port Richmond Iron Works of Isaac P. Morris, in 1852, or at the same time I was placed there. He went into the drawing office, where I also entered after spending two years in the machine shop. He was something more than a draughtsman or only a man in charge of a drawing office. He was an engineer with a mathematical education of a no mean order for one appearing at the dawn of a new art—fully equipped to meet all the conditions it presented—in fact, Shields Wilson was so equipped that he became one of the pioneers in what today is known as naval architecture—like the engineer who became the pioneer in the composite architecture now demanded on land. Mr. Wilson made quite an imprint on the work of the day. He was connected with the building of the metal hull as well as the engine and boiler. It was he who made the steam reverse gear a success by introducing in 1869 the floating lever to control the admission of steam into the reversing cylinder. It was he who designed the engines and boilers of the first double-ended screw ferry boat built in this country.

We were more or less together until 1879 when he resigned as superintendent engineer of Cramp & Sons and the position was given to me. I can, therefore, state with some emphasis that the general design of engines and boilers did not include a complete pipe plan until after 1870, or after he had left the Penn works, which can be readily understood as the entire force in the drawing office of the Penn works, including himself, consisted, for most of the time, of two men and one boy, in extreme cases of not more than three men, who had as much as they could look after in designing only part of the work without touching the pipe or boiler plan, as shown by the extent of the orders which in 1869 included 49 engines and boilers off of 22 different patterns, also three iron vessels, the Pocahontas, Charles Pearsons and Havana.

The Man Higher Up to Blame.

The absence of the concrete design previous to 1870, I beg leave to state, was not due to the opposition of the foreman boiler maker or to that of any other foreman, but to the man higher up—the boss or manager without any technical education or the man who must see the real thing, who could not fathom a drawing but must have a working model to clear the way. I have known him to stop before a drawing board where something new was being developed. "I suppose this is science." He was continually at variance with the engineer in charge. It was he who placed the heads of the mechanical branches above the engineer, it was he who had the work done by the foreman without first having a well digested plan prepared in the office. He, therefore, was the one responsible for a system leading not only to endless alterations but also to marring the success of the main design. This opposition, consequently, kept down the size of the office force so that it was unequal to cope, even if it desired, with more than the general plans and some few of the details, thereby necessitating the ordering of the material and the planning of the staying of the boiler to the foreman boiler maker and the arrangement of the piping, outside the main steam and other large pipes to the machinists.

An awakening was necessary before there could be any hope of a change. This did not come until the size of the work demanded something better than the rule of thumb, not until concerns with engineers in full charge led the reform and compelled the laggards to adopt similar methods if

they did not want to be left behind. This awakening was first manifest abroad, where a new order of things had been created, where the engineer, through his connection with the building of the metal vessel, founded the new order of naval achitecture in place of the old-time one where wood was the basis.

Engine Builder Leader in the Metal Vessel.

The engine builder had to lead in the construction of the metal vessel, as the ship carpenter was not prepared either by inclination, or equipped with the necessary knowledge of the new art, and without the facilities required in connection with it, consequently the construction of the hull had to fall largely upon the boiler maker, whose line was nearest to it and as he was accustomed to accurate workmanship, to fit close, and to rivet tight, he was just the man to take it in charge. If many of the vessels were fearful specimens of naval architecture, it was not due to this man or his workmanship, but to the model, which in many cases was obtained from the ship carpenter following the uncertain method of whittling and sand-papering said model into such shape as pleased the eye, who did not work out the lines on the drawing board, so it is reasonable to assume that if the vessel failed to accomplish what was desired, the failure could not be charged up against the builder of the hull but to the one who furnished the model, for if the workmanship was good it is more than likely that the lines were much nearer those of the model than if the vessel had been built of wood, or by a method from which as a rule no two vessels off the same model would be alike, whereas in the metal construction there is, we know, a much closer resemblance or following of the model.

Building Good Sized Vessels.

Some other vessels constructed by these engine builders were of no mean size or of inferior design, running in those days up to sea-going ships 225 ft. long, with frames of angle iron, as the mills had begun to turn out this shape. One iron screw vessel 210 ft. long started in 1860 was from the plans of an engineer and pioneer naval architect, John Baird, of this city, who was assisted in the work by his daughters. He was a man who designed and built the elevated railroad on Greenwich street, the first, if I am not mistaken, of its kind in this or any other country. The old note book in my hand shows how elaborately the details of the construction of the hull were carried out, particularly the foundation for engine, which was a single expansion inverted cylinder, one with a cylinder 60 in. diameter by 54 in. stroke of piston. The beams of the vessel were built up of plate and angle irons as the mills were not yet prepared to roll outside of angles and H beams. The strength of the vessel and the care taken to build her is shown from the fact that the butts of some of the sheets of the outside plating were double-strapped, the 9/16-in. plating being a strap of the same thickness on the outside and a 7/16-in. one on the inside. The time taken to build was 14 months and two days. This vessel was, as stated above, started in 1866, so you see the facilities could not have been so bad at this early date.

We later built the "Havana," another iron screw ship, also designed by Mr. Baird. She was 225 ft. long, fitted with a single expansion inverted cylinder engine, with a cylinder 60 in. diameter by 60 in. stroke, driving a four-bladed screw propeller 14 ft. 5 in. diameter. This vessel was on the stock at the time of the battle of Gettysburg and took over 17 months to build on account of the disturbing conditions at the period.

Prejudice Had No Weight.

It is my belief that prejudice did not to any great extent prevent the early departure from the old to the new engine—that it was not responsible for the continuance of the employment of the paddle wheel in reference to the screw propeller, but that it was due to the ability of the former to accommodate itself or to be more readily realigned to meet the change of shape of a lighter and less rigid hull, whether made of wood or iron, and that the general adoption of the direct connected screw propeller engine had also to wait until it had been found to fill all that had been accomplished by the paddle wheel. It was also perfectly natural at first that those who built paddle wheel engines, consequently perfectly familiar with them, should, when a screw ship was desired, prefer combining the above engine with the screw propeller through the medium of gearing instead of employing the direct connected one with which they had limited or no experience. The latter engine had its peculiarities which had to be learned before it could be successfully installed, as the one which would work satisfactorily on land would not do so on shipboard, if provision had not been made to meet the different conditions found there. The higher speed engine also demanded fastening to the hull different from what had been the custom in the case of the slower side wheel as the area of the foundation was smaller and the vibrations more frequent, so the builder of the side wheel engine went slow, but eventually adopted the direct connected, like the builder of the wooden hull adopted the metal one after he had found himself.

Mr. Edwin A. Stevens.

Edwin A. Stevens: It will give me great pleasure to suggest that some of the drawings, referring to the Stevens battery, would be of interest to the members of the society in their reference to the paper, and if such is the fact, I will be glad to contribute such drawings as part of the discussion. I will show that Col. John Stevens abandoned the use of the propeller after his experiments of 1804, for the reason that he was led by the experiments on a vessel at that date, a small launch 20 ft. long, to conclude that the diameter of the propeller necessary for the commercial navigation of the Hudson river would be so great as to prevent the boat from passing over the Overslaugh shoal, and thereby bar the vessel from access to Albany, and the statement that he was influenced in passing from the use of the screw propeller to the side-wheel, by his son, Robert S. Stevens, is perfectly correct and accurate. That I believe to be the fact, but Col. John Stevens, to the end of his days in the late '30's was always a constant advocate of screw propulsion. He always claimed that screw propulsion would eventually supersede propulsion by side wheels, and merely waited for the perfection of the steam engine to allow the use of propellers of small enough diameter to become practicable.

Chairman Taylor: I am sure the society will agree that these drawings Col. Stevens has referred to will make a valuable addition to the papers of this society, and if there is no objection we will accept his invitation with pleasure.

William Conant Church.

William Conant Church: (Communicated.) Depending, as he apparently does, upon that most fallible of all records, the memory, Mr. Camp

has been betrayed into some errors of statement in what he says concerning John Erricson in his paper upon the "Evolution of Screw Propulsion in the United States." Erricson's knowledge of and experience with many mechanical contrivances in common use today dated so far back of any existing recollections that he was supposed to have copied from others what he, in fact, originated himself, or certainly first brought into use. John Bourne, C. E., in his "Treatise on the Screw Propeller," London, 1852, speaks of Erricson as "well known" at the time he introduced the screw "as a mechanician of great originality and skill." (Page 87.) Bourne also speaks of the canal boat "Novelty" fitted in 1887 with Erricson's propeller as "the first example of a screw boat being employed for commercial purposes." Bourne further refers to Erricson as "an accomplished engineer," whose mechanical resources were such that he "threw the dogmas of engineers to the winds, and coupled the engine immediately to the propeller."

The Robert F. Stockton.

The Robert F. Stockton, which was equipped with Erricson's propeller, reached New York May 29, 1839, and nearly 30 years afterwards was still doing duty on the Delaware and Rariton Canal. On Nov. 17, 1866, Bennet Woodcroft, then librarian of the British Patent Office wrote to Erricson asking him to send the original engines of the Robert F. Stockton so that they might be placed in the Patent Office Museum. The Stockton, or New Jersey, was at this time in the possession of the Messrs. Stevens of Hoboken. Erricson offered to replace the old engine with a new one, but without avail, and on Aug. 15, 1873, he wrote: "Nothing could induce the Messrs. Stevens, who claim to be the originators of screw propulsion, to permit the machinery of the real screw vessel to be placed in your museum. Accordingly, some time ago the Robert F. Stockton was hauled out of the water and cut up, each plate being separated from the others, while the machinery was broken up and put into the melting pot. So careful were the parties mentioned to prevent the smallest part to remain as a proof that the remarkable vessel once existed, that 'not a vestige now remains,' says my informant, who has access to the premises where the vile act of destruction took place. A meaner proceeding cannot well be imagined, but I expected nothing else, since it leaked out during the negotiations what the old machinery was wanted for." This letter was in response to one from Mr. Woodcroft of a month earlier saying: "The benefit you have conferred on the world by the screw propeller is beyond computation."

Erricson's Screw in Revenue Cutters.

Within five years of the time of Erricson's arrival in this country he had fitted his screw to the Revenue Cutters Legare, Jefferson and Spencer and by 1859 the Erricson propeller had been applied to six government vessels. The *London Engineer* of May 11, 1866, said: "It is worthy of notice that Erricson applied his propeller to upwards of 60 vessels in America before any other form of propeller was adopted, nor is it less worthy of remark that the adoption of his propeller proved a great commercial success from the start, many of the original vessels being now, after 15 years of service, in good working condition." The Encyclopedia Britanica declared that "a small vessel fitted with a propeller patented by Erricson was the first brought into practical use." The Queen's Privy Council in renewing Erricson's Patent in 1850, passed favorably upon Erricson's claim of the priority and merit of his invention.

Dionysius Lardner in his popular Lectures on Science and Art, New York, 1846, says: "The triumphs of genius are not unattended with alloy. The moment that any invention proves to be successful in practice a swarm of vermin are fostered into being to devour the legitimate profits of the inventor, and to rob genius of its fair reward. Capt. Erricson, so long as his submerged propeller retained the character of a mere experiment, was left in undisturbed possession of it; but when it forced its way into extensive practical use—when it was adopted in the United States Navy and in the Revenue service—when the coast of this country witnessed its application in numerous merchant vessels—when it was known that in France and England its adoption was decided upon—then the discovery was made for the first time that this invention of Capt. Erricson's was no invention at all—that it had been applied since the earliest dates in steam navigation. Old patents, some of which had been still-born, and others which had been for years dead and buried—were dug from their graves, and their dust brought into courts of law to overturn this invention and wrest from Capt. Erricson his justly-earned reward."

Screws for Foreign Naval Vessels.

The designs for the machinery of the first British naval steamer, the frigate Amphion, that carried a propeller was made in New York in 1844 by Erricson. A year earlier Count Von Rosen, Erricson's general agent, received an order from the French government to fit a 44-gun frigate, the Pomone, with a propeller on the Erricson plan. Feb. 8, 1848, Count Von Rosen reported saying: "Now there are upward of 5,000 H. P. of engines made or in course of construction, applied or to be applied to screw ships on our system." This statement is confirmed by Bourne, who says: "Erricson's propeller having been the first successful propeller that was introduced into France, has in consequence obtained a wide acceptation in that country."

Not Erricson's Gun That Burst.

Mr. Cramp says: "There were several short trials of the Princeton and the explosion of Mr. Erricson's great gun on the last one killed many prominent guests, among them two members of the Cabinet." If Mr. Cramp will inquire further he will learn that it was not Erricson's gun, the "Oregon," that burst on the Princeton, but one made by Commodore Stockton in imitation of it. In a letter addressed to me Sept. 18, 1890, Commodore William N. Folger, U. S. N., then Chief of the Bureau of Ordnance, said: "The 12-in. gun, called the Oregon, is now at the Naval Academy, having been sent there in July, 1867." Stockton's gun split through the center under very moderate charge on the steamer Princeton. It had been previously injured by a hollow shot too large for the bore, which had been forced home with great effort. The wording of Mr. Cramp's paragraph from which I quote would indicate that the trials of the Princeton referred to by him terminated its career. On the contrary, so thorough was the work upon the Princeton that after serving through the Mexican war, and doing more duty than any other naval vessel, she was sent to Europe without being repaired. Her success was the final triumph of the principle of screw propulsion. On her visit to the Mediterranean she attracted the attention of the curious and of the skillful engineers of every naval power. Commodore Stockton says: "Her speed and sailing qualities, her ad-

mirable model, the impregnable security of her motive power (being placed below water line), and her powerful armament made her an object of universal admiration. Wherever she appeared immense crowds gathered to witness her evolutions and inspect her machinery." A Committee of the American Institute, of which George C. DeKay, a celebrated ship builder, was chairman, announced that this vessel was "in every way worthy of the highest honors of the Institute—a sublime conception most successfully realized, an effort of genius skillfully executed, a grand, unique combination, honorable to the country as creditable to all engaged upon her." Bennett Woodcroft in his "Sketch of the Origin and Progress of Steam Navigation," 1848, says: Notwithstanding the unfavorable and discouraging results of Capt. Erricon's attempts to obtain for his discovery the patronage of the Lords of the Admiralty, it should in justice be stated that few inventions ever elicited such approving notices from the press: Accounts of the several experiments appeared in the *Times* and other public journals; also in the *Civil Engineers and Architects Journal*, the *London Journal of Arts and Sciences*, the *London Mechanics Magazine* and other similar publications. (Page 98.)

Influence on Rail Rates.

Woodcroft notes the fact that "the introduction of the first screw steamer, the Erricson, between Philadelphia and Baltimore by the inland route, via Chesapeake and Delaware Canal completely annihilated as a profitable speculation one of the greatest works in the country, the Philadelphia & Baltimore railroad." It was obliged to reduce its fare one-half and though the state protected its passenger trips by imposing a prohibitory toll on passengers going by the screw propeller line, its freight business was lost forever. (Pages 101-2.)

"It will thus be seen," says Woodcroft, "that Capt. Erricson accomplished for the screw propeller in America and England, what Fulton did for the paddle-wheel in the former and Bell in the latter country, namely, its practical introduction." (Page 192.)

These facts serve better to account for the success of John Erricson than the circumstance that he was a man possessed of great "conversational ability." He was undoubtedly an earnest and convincing talker on subjects he thoroughly understood, but he was convincing because he spoke from a knowledge and experience of engineering matters superior to that of any other man of his time. This fact could be clearly demonstrated by a review of his history previous to his advent in this country and his career subsequent to that time.

Perhaps it may be well for me to say that I speak with some authority on this subject as I was literary executor for John Ericsson, and all his papers were turned over to me at the time of his death, and are now in my possession. This is not material, however, as this is not an expression of opinion, but a statement of facts for which the authority is given.

Mr. Herbert C. Felton.

Mr. Herbert C. Felton: (Communicated). The very interesting paper of Mr. Charles W. Cramp, on "Evolution of Screw Propulsion in the United States" recalls the wooden steamships with beam engines and paddle wheels built by the Novelty Iron Works for the Pacific Mail Steamship Co. and referred to in his paper.

It was my fortune to be employed in the draughting room of the Novelty Iron Works from 1866 to 1869, during which time the last two or three or these ships were completed. Ten or twelve vessels in all of this type were made for the Pacific Mail Company, the machinery for all of which was made and installed by the Novelty Iron Works. These beam engines were 105-in. diameter of cylinder, 12-ft. stroke, with paddle wheels 40 to 45 ft. in diameter by 12 ft. face.

The boilers were made to carry 3 lb. of steam. The condensers (surface) were square cast from boxes with compressed wood thimbles for tube packings. I recall the trouble referred to in breaking of the shafts, and to overcome this it was proposed to construct one of these ships without the usual outboard bearings. On the outside of the wooden hull an extensive plate iron construction was designed, to be screw bolted to the hull and on which was to be placed the shaft pillow block or bearing; this carrying the weight of the wheel and the overhanging shaft. In order to do this the wheel was to be "dished"—that is the hubs moved closer together and the arms bent to suit. I am not entirely sure that this construction was adopted, but I distinctly recall the drawings made for this purpose.

It was frequently my duty to work up the indicator cards and engineer's log. My recollection is that the economy shown was 2 3/10 to 2 5/10 lb. of coal per one horsepower per hour.

The Novelty Iron Works.

Previous to and during the Civil War the Novelty Iron Works was probably the most extensive steam engine works in the country, and during the war the machinery for many gun boats for the U. S. Government was built and installed in wooden hulls, built for outside parties.

The machinery for the sloop of war "Wampanoag" was built and installed by this same company about 1868. The engines, designed during the time of Chief Engineer B. F. Isherwood, consisted of two horizontal engines 100 in. in diameter of cylinder by 48-in. stroke—geared to the propeller shaft—2 to 1. The propeller was 20 ft. diameter by 25 ft. pitch. She had 12 large boilers and the bunker capacity for coal was very much cramped. On her trial trip she developed very great speed for that period.

Referring again to the large beam engines: When the cylinder was finished for the first of these large engines I understand that a table was set inside of same and twelve to fifteen officials sat down to a banquet. I think, however, that these cylinders were exceeded in size by beam engines installed on two Sound steamboats; these were 112 in. diameter by 12 ft. stroke and were built about 1867 by the Morgan Iron Works.

Mr. D. W. Taylor.

D. W. Taylor: It seems to me there has been some reference to the Ericsson propeller that it might be of interest to recall to the members of the society the principal features of the Ericsson propeller, as I understand it. I believe the early Ericsson propellers consisted of a short cylinder or plate of cast iron, which was secured by several arms to the hub, and then there were a number of blades of helicoidal shape stepped around on the cylinders, as many as six or eight, and it was that type of propeller which Ericsson advocated strongly to the English Admiralty in the late thirties, at the same time when a farmer named Smith was advocating a different type of propeller, which consisted essentially of two blades, having almost complete convolution and built of wood, and Mr. Smith had the advantage of a banker who backed him, and he finally succeeded in getting the Admiralty to

try his propeller, and they turned the Ericsson propeller down. It was at this time that Ericsson shook the dust of England from his feet and came to the United States. The propeller afterwards made a good deal of progress in France, but not much in England. After one of the Smith propellers had the good fortune to strike a rock which carried away about half of its surface, the vessel made about two knots more speed.

Prof. Herbert C. Sadler: I understand that the society has practically decided to go to the great lakes next summer. I believe there is one of the Ericsson original propellers lying on the banks at the lock at the Soo.

Screw Boat Vandalia.

Chairman Taylor: Is there any further discussion? If not, as a matter of record, but of no particular interest, I wish to make a few remarks. I was looking over a scrap book last Sunday, which belongs to a member of council, Mr. Kirby, and there was a letter from Mr. Ericsson saying that his propeller was much superior to that of Mr. Loper, and would finally succeed, and also in this same scrap book were drawings of Ericsson's first attempt, of the first attempt of anybody, and the drawings were made by Mr. Ericsson, of the engine for a screw boat, built on the lakes, the steamer Vandalia, and I do not know but that that is the propeller to which Prof. Sadler has referred. There was also in this same scrap book a request from John Fish to Robert F. Stockton to pay some one a certain amount of money, which was due him for work on the steamboat, and that was back in 1787 or 1788.

These little reminiscences of mine have nothing to do with the paper, but it happens that I saw these things last Sunday, and in connection with the paper they become interesting to me, as I trust they are to you.

The Effect of the Parallel Middle Body Upon Resistance

THE second paper was entitled "The Effect of Parallel Middle Body Upon Resistance," by Naval Constructor D. W. Taylor. This paper is best abstracted in Mr. Taylor's own words as follows:

"The paper gives the result of an investigation into the effect of resistance upon full vessels of varying percentages of parallel middle bodies. The data as to the parent form, and the method used in the perfection of the models, are given here on pages 1 and 2, and in the figures Fig. 1 to Fig. 3. I should like to call attention to an error in the table at the extreme end, which was brought to my attention this morning by a member. You will find in the second column, the bottom of the second group of columns, series No. 26, beginning model No. 951 and ending model No. 970, the breadths in feet are wrongly given. The breadth for the 3,000 pound model is given as 1.682, and it should be the breadth as given for the 1,000 model, namely 2.913. These breadths are reversed accidentally. Upon investigation of the effect of parallel middle body, as stated in paragraph 4, it was found that the wetted surface changed very little indeed, so that for the effect upon resistance, we may practically neglect the variation in the wetted surface due to the variation in the length of the parallel middle body. Beginning on page 3, paragraph 5, the question of residuary resistance is taken up, and we finally derived Figs. 8, 9 and 10, which really give in condensed form the net result of the experiments. These show that broadly speaking, from the point of resistance alone—(and I want to emphasize that this paper refers to resistance alone, and there are many other factors to be considered in the design), for the range of speeds attained in practice by full vessels, the optimum length of parallel middle body is, for a longitudinal coefficient of 0.68, from 12 to 16 per cent, but it may be made 25 per cent, without material increase in resistance. For a longitudinal coefficient of 0.80 the optimum length of parallel middle body is from 32 to 35 per cent, but it may be made from 44 to 48 per cent, without material increase of resistance. These conclusions apply to values of speed-length coefficient above 0.50. For very low speed vessels, the residuary resistance is such a small percentage of the total that the limits above may evidently be materially exceeded."

Discussion on Taylor's Paper.

Capt. W. Hovgaard: This is a paper which I think should have considerable interest for shipbuilders. I think it would add somewhat of value to the paper if further results were given—results similar to those given on Fig. 5, I mean the results for the two other coefficients of fineness. Here on Fig. 5 we find the results for the longitudinal coefficient of 0.74. I think it would be of value to have it also for the two other coefficients if the experiments have been made.

I would like to know if Mr. Taylor has made any experiments on models with varying parallel middle body, but with the same ends. The experiments here given relate to varying lengths of parallel body, but at the same time with varying fineness of the end. In the '70's Mr. William Froude made experiments with models, with different ends on the middle body, and then he found that the residuary resistance was the same, that is to say, the average or mean residuary resistance was the same for all these different lengths of middle body, and that the fluctuations were those due to the wave interference only, so that at a given speed the residuary resistance curve would go in a wavy line above and below a certain line, wholly independent of the length of the middle body.

I do not quite understand the way that the different forms are derived from the parent form. It is described at the foot of page 1.

Referring to Fig. 2, I do not quite see clearly how the location of the ordinate of the derived form is gotten at, I think perhaps Mr. Taylor might explain that more fully—it may be that I ought to see it, but I do not quite understand it.

Prejudical to Speed.

The statement is made on page 3, as follows: "It is interesting, however, to note that at the very high speeds any parallel middle body is prejudicial to speed, the curves arranging themselves in the order of the percentages of parallel middle body." We might also say that the curves were arranged then in the sequence of the obliquity, because with the shape adopted the greater the length of parallel middle body is, the greater also is the obliquity, and that, I think, might be expected, that the greater the maximum obliquity of the water and lines at the ends, the greater must naturally be the changes in the velocity of flow past the body, and therefore the acceleration and pressures and wave forms are likely to be increased.

Prof. Herbert C. Sadler: I think the society is certainly indebted to Naval Constructor Taylor for another of his very valuable papers. One of the most important points in connection with this paper is that the displacement has been kept constant throughout, also the general

dimensions of the model. Directly you begin to change displacement by adding middle body, or lengthening the model, you really alter all the conditions. The shape of sections also remaining the same, has eliminated any chance of differences in results being obtained due to the shape of sections. In experimental work there is always a tendency to make too many changes at the same time, and the results therefore, are more or less vitiated. One cannot tell exactly to what is due the change in resistance.

One thing that must strike everybody in connection with the curves shown on Figs. 6 and 7, I think, is that never mind what the displacement of any particular model is, or the displacement length, that up to a certain parallel middle body, the residuary resistance is practically independent of the displacement; that is, it has practically the same value. When we pass a certain diameter of parallel middle body, however, the effect of increasing displacement, of increasing both length and breadth, is immediately important.

I would like to ask Mr. Taylor if some time in the future he would saw some of his models in half and try the effect of the combination of different ends. I have found, in experimenting with certain models, that the easier form of after-body drives with rather less resistance than the rather fine form, and I think possibly the minimum resistance would be reduced if Mr. Taylor took his best bow and tried some of the other forms with slightly less middle body and the fuller form immediately aft.

Mr. Thomas M. Cornbrooks.

Thomas M. Cornbrooks. (Communicated.) I am very much interested in this article by Mr. Taylor, as it is of great value to those of us who are anxiously wrestling with problems of this sort, which are intimately associated with both the cost of building and in running steamers of this type.

We are very fortunate in having the results of model tank experiments of two ships which fall within the range of this paper. As the results fall very close to the curves given on Figs. 7 and 10, I append herewith a data of these trials. Ship No. 1 is 488 ft. between perpendiculars, 58 ft. beam, and was tried at two draughts, data for which I shall give as A and B.

A—12 knots speed. Percentage of midship body 42

E. H. P. 1630

F. H. P. 1410

R. H. P. 220

$\frac{V}{\sqrt{L}}$ .51

$\frac{D}{\frac{(L)}{(100)}}$ 98.2

L. C .75

Midship section coefficient.... .97

Rr. lbs. per ton displacement .52

Displacement 11410

B—12 knots speed. Percentage of midship body 42

E. H. P. 1882

F. H. P. 1407

R. H. P. 475

$\frac{V}{\sqrt{L}}$ .51

$\frac{D}{\frac{(L)}{(100)}}$ 145.3

L. C. .80

Midship section coefficient.... .80

Rr. lbs. per ton displacement .76

Displacement 16892

No. 2 ship is 385 ft. between perpendiculars, 53 ft. beam, and was tried at load draught only.

12 knots speed. Percentage of midship section 31

E. H. P. 1780

F. H. P. 1050

R. H. P. 730

$\frac{V}{L}$ .61

$\frac{D}{\frac{(L)}{(100)}}$ 196

L. C. .80

Midship section coefficient... .569

Rr. lbs. per ton displacement 1.76

Displacement 11200

Chairman Taylor: Does Mr. Taylor wish to add anything to the discussion this morning?

D. W. Taylor: I will say with reference to Prof. Hovgaard's remarks, that I should be glad to add to the paper when permanently printed the additional curve of residuary resistance of the models with the 0.68 and 0.80 longitudinal coefficient. My only object in leaving that out was to reduce to some extent the size of the paper. If it is of interest to the members, I shall be glad to add them.

We have made no experiments with varying models, having identical ends and varying length of parallel middle body. I think that Mr. Froude's classical paper on the subject leaves very little to be covered by the general features which would be found, and that is not a problem of serious practical interest, as a rule, because you seldom can vary the length of the ship very much, when it comes to be designed.

I will have to take Prof. Hovgaard aside and explain how these derived forms are obtained. I tried to make the matter plain, but if I did not, I will take him aside and explain it.

In regard to Prof. Sadler's remarks, we have made a number of experiments with various ends of models, having the same parallel middle body. We built models with separate ends, and bolted them together, and as long as the midship sections were the same, we could combine any bow with any stern. We have done none of that with the parallel middle body model.

The Influence of the Position of the Midship Section Upon the Resistance of Some Forms of Vessels.

PROF. H. C. Sadler then read his paper entitled "The Influence of the Position of the Midship Section upon the Resistance of Some Forms of Vessels." The paper follows:

The following experiments represent a short investigation of the influence of the position of the "midship section" upon resistance, this term being used to designate the section of maximum area. The two sets of models tried were of ordinary form, and in each series the length, breadth, draught, displacement, sections and curve of sectional areas were kept constant, the only variation in the form being that due to expanding or contracting the forward and after body due to placing the midship section at various positions in the length.

When the midship section is at the center of the length, the curves of sectional areas in both models were the same for both forward and after bodies. Although this form of curve of sectional areas is not necessarily the best, it was adopted in this particular series on account of some other investigations.

PARTICULARS OF MODELS.

TABLE 2.

Mod.	$\frac{L}{B}$	$\frac{B}{d}$	$\frac{L}{d}$	Coefficients.— Block.	Prism.	Mid. sect.
A	8	2.143	17.14	0.503	0.538	0.935
B	8	2.143	17.14	0.567	0.606	0.936

Model A has a rather low prismatic coefficient for a vessel of ordinary form, but this again was chosen in view of future experiments.

The curves of sectional areas for the two models are shown in Fig. 1. In each case the midship section was placed in four positions: (1) at the center of the length; (2) at 5 per cent of the length aft of the center; (3) at 10 per cent aft, and (4) at 10 per cent forward of the center. The curve for sectional areas for (2) is omitted and that for (4) is not shown as it is simply (3) reversed.

The curves of residuary resist-

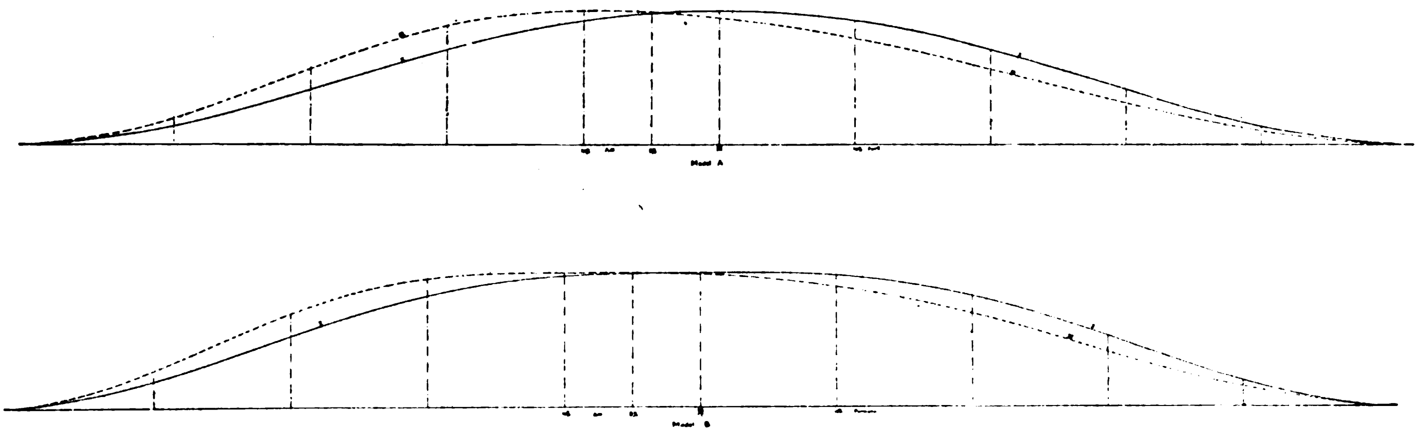


Fig. 1.

ance for model (A) are shown in Fig. 2, the base representing the position of the midship section with respect to the length, and the ordinates to each curve, the residuary resistance for a constant speed-length ratio.

It will be noticed that at the low speeds the position of the midship section has little or no influence upon the resistance, but as the speed increases there is a certain position for each speed where the resistance is a minimum. This position travels aft as the speed increases. With the midship section 10 per cent aft or 10 per cent forward of the middle of the length the resistance shows a marked increase at the higher speeds.

The results for Model B are shown in the same manner in Fig. 3. In general the curves follow in the same lines as those for Model A. In this case, however, as the model is of somewhat fuller form, the minimum occurs at a slightly different place and the effect of the position of the midship section is noticeable at a smaller speed-length ratio.

In both models, when the midship section was placed at 10 per cent of the length aft of the center the flow around the after body seemed somewhat disturbed. This was doubtless due to the hollow form caused by the closing up of the sections, and the performance in this particular case could doubtless be improved by filling out the after body at the stern and easing the form immediately aft of the midship section. Such modifications, however, would destroy the main object of the above investigations, which show the effect of the position of the midship section only, everything else remaining constant.

In reading the paper Prof. Sadler said in explanation: I would like to call attention to one error which unfortunately was discovered after these plates were made. The speed wave ratio of 0.9 for the midship section, 10 per cent forward of the middle, the ordinate should be about 3.6, instead of 2.6. This curve for 0.9 speed length ratio should rise a little more rapidly on its right hand side.

Location of Center of Buoyancy.

D. W. Taylor: I would like to say one word in expression of my appreciation of Prof. Sadler's paper. It seems to be it brings out one or two facts which are likely to be of very great practical value and interest. There is a general impression among the people who have worked on model tanks for a number of years, I think in England more particularly, that it is desirable to place the center of buoyancy of the ship a little abaft of the center of length. Some naval architects do not agree with this theory, but I think that the tank people are nearly all of the opinion that the center of buoyancy should be slightly abaft of the center of length. Prof. Sadler's experiments certainly confirm that point of view as far as that goes, because by shifting the midship section he shifted the center of buoyancy. As a part of our regular practice, at the model basin, we test models on an even keel, by the head and by the stern, and it

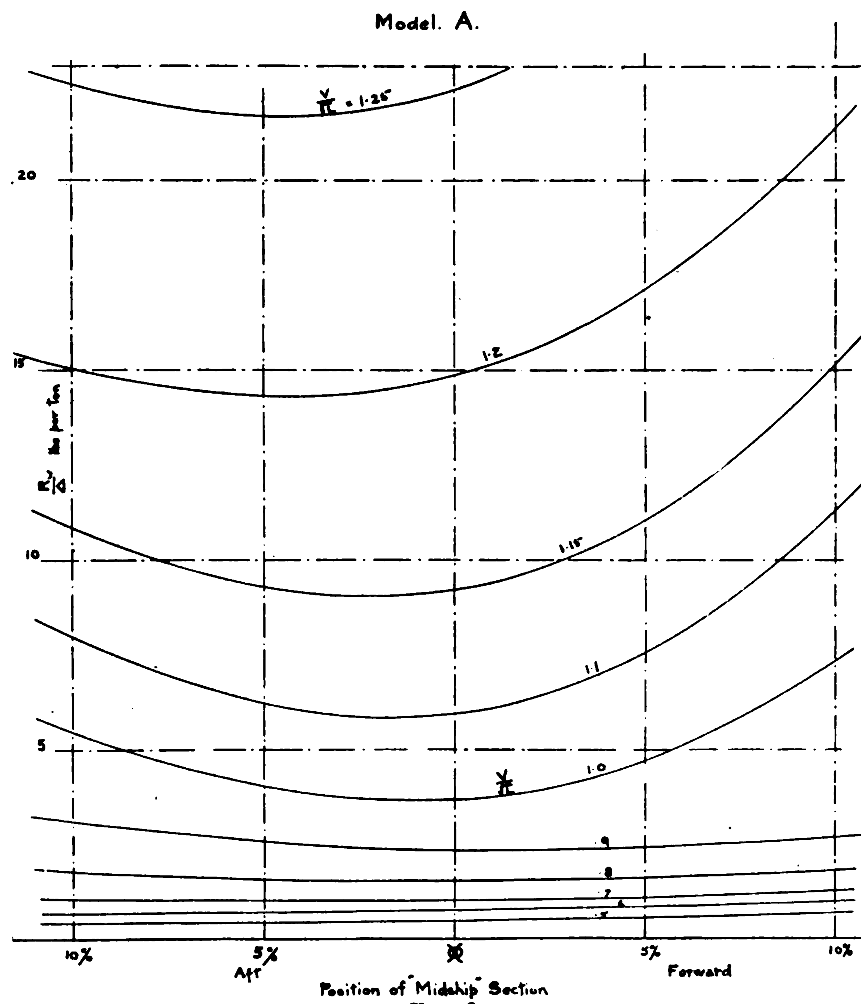


Fig. 2.

is our experience that as a rule they run slightly better by the stern and slightly worse by the head. The difference is slight, and may be entirely utilized in many cases by a change in difference of form of model, but taking a broad average they seem to run slightly better by the stern than by the head, and that was also very strongly the opinion of a majority of seagoing people. They prefer to have the ship trimmed by the stern, and they say that the vessel will go through the water better. I think, however, that many seagoing people exaggerate that.

There is one thing—looking at Figs. 2 and 3, the last figures, it is seen that there is a distinct minimum of resistance for a number of the curves—as pointed out by Prof. Sadler, when the midship section is between the central position and five per cent aft, but you will see that the strong minima, referred to the curves of the speed length of coefficient, of 1.0 above, and for the speed coefficient from 0.9 down. The difference of the variation in resistance, when the midship section is as much as 5 per cent aft, is really very small, and after all, I presume that 95 per cent of the ships built have a speed length ratio of less than 0.9, and that is somewhat encouraging, as it encourages us to believe that we may vary the position of the midship section somewhat, from the position of center of buoyancy if desirable, in consideration of freedom from errors, without any serious prejudicial effect on resistance, and I think this a very desirable thing to know.

Effect of Raking Midship Section.

E. A. Stevens: I ask if the effect of raking the midship section has been investigated? It has a bearing, to a certain extent, in the case of torpedo boat models, etc., which seems to require that the greatest width of the water line should be aft of the position occupied by the lower lines. That form of vessel is gotten up more especially for high speeds, particularly higher speed ratios.

Prof. Sadler: I would like to confirm what Mr. Taylor has said in regard to the general tendency of vessels when they are trimmed by the stern or by the bow, in connection with resistance. We have found the same thing that usually most vessels drive a little easier when trimmed by the stern. In the case of some of the very full types, however, the reverse seems to be true, with certain models. I have found some with

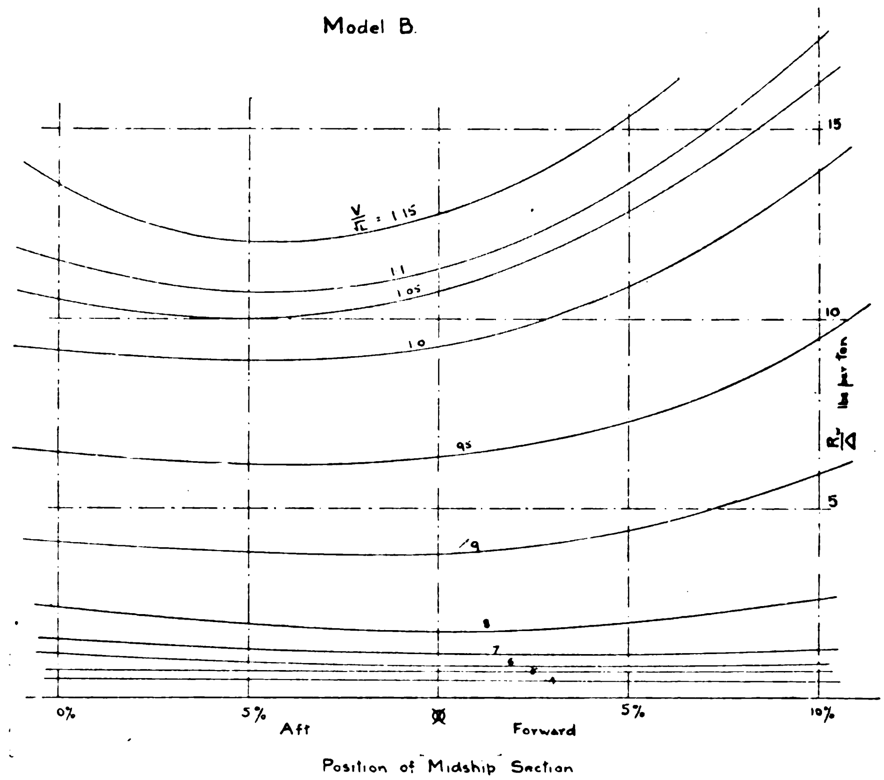


FIG. 3.

very full ends that seemed to drive a little easier when trimmed by the bow.

With regard to raking the midship section, personally I have not tried any experiments on that up to the present. We hope to do so at some time in the future. I would not like to say off-hand what the result of that would be on different types.

Some Ship-Shaped Stream Forms.

THE fourth paper was upon the subject "Some Ship-Shaped Stream Forms," by William McEntee, assistant naval instructor, being the results of an investigation made at the experimental model basin in Washington while the author was on duty there. The investigation had for its principal object the determination of the variation of velocity of water when constrained to move in a plane along a form of the shape of a ship's waterline or more properly, water plane. The main conclusions from the investigation are: First, that hollow waterlines cause less wave-making disturbance than straight or convex waterlines and that, as the hollowness and fineness of waterlines are increased the wave-making disturbance decreases to a minimum after which, if the lines are made still finer and hollower, the wave-making disturbance again increases.

Discussion on McEntee's Paper.

Capt. William Hovgaard: Mr. McEntee states on page one two main conclusions, and the last of these is that "as the hollowness and fineness of water lines are increased, the wave making disturbance decreases to a minimum, after which, if the lines are made still finer and hollower, the wave making disturbance again increases." That conclusion corresponds very well with an analysis which I have made of a great number of water lines, and of the resistances of a great number of ships, and these analyses were published in the transactions of the British Institution of Naval Achitects last year. In examining the obliquity of a great number of water lines on actual ships, I find that the obliquity could be represented by a formula. (Constructs formula on the blackboard.) You will find first in the very full lines the obliquity is very light, and then it decreases, and there will be a minimum, after which it will again increase with the very fine lines, so that the obliquity becomes a form equally present, and becomes a parabola. This is the value for which the obliquity is a minimum. (Indicating on blackboard.) That value is found to be about 0.55. I also analyzed the residuary resistance of a great number of ships, and found that it could

be expressed by a similar formula, dependent on the horizontal coefficient. The formula for that would be quite similar. (Capt. Hovgaard here presented another formula on the blackboard.) It would be that the resistance would be equal to some constant, plus another constant, (additional formulae), the minimum resistance was found, with a horizontal coefficient, to be 0.53. Now, it seems to be Mr. McEntee's conclusion that the wave making disturbances will likewise decrease to a minimum. It would be interesting if Mr. McEntee would give us the value of the coefficient of the third line at that momentum. I do not think that is stated in the paper.

Influence of Beam.

As regards the influence of beam, the transverse dimension Mr. McEntee states that the maximum pressure head is approximately proportioned to the beam. If the maximum pressure head is proportioned to the beam, that would mean that the wave height would also be proportioned to the beam, and as the residuary resistance is proportioned to the wave height square, that would make the residuary resistance approximately, at least, proportional to the beam square. That again corresponds with the result which I arrived at in same analysis of resistances, where I found by a change of dimensions only, that is, keeping the coefficient of fineness the same and expanding along the depth scale, that the residuary resistance would be as the beam square. That would also correspond with Mr. McEntee's conclusions here.

Velocity and Pressure.

D. W. Taylor: This paper by Mr. McEntee carries further some investigations which I made a good many years ago, and I should like to say a word or two in connection with it, particularly as I believe the subject is likely to be carried very much further in the near future. The question of the velocity and pressure distribution in two dimension motion, a motion such as that of the strut of a propeller blade through the water, a motion in two dimensions, has been reduced entirely to mathematics. We know theoretically what it would be around an ellipsis of any form, but the trouble is an ellipsis is not a practical form for ship shape form, and the difficulty has been to determine the stream form with the sharp edge. The stream form I worked on many years ago almost necessarily brought out a slightly round in front, might bring it out something like that (sketching on the blackboard) very hollow or round, but they all had a slight round, so that when the water struck this round the pressure at the extreme point was entirely that due to the velocity head, and the curve of pressure would come to a stop there (illustrating on blackboard), and drop off rapidly. What Mr. McEntee has done has been by graphical methods to develop a sink and source line, so that he can get a mathematically sharp edge there and that is quite an advance.

The difficulty we have, as with all of this work which has been done scientifically, as far as I know, is that it has to be done graphically, and that involves a great deal of labor. There has been a great deal of labor put on this paper of Mr. McEntee's in doing the graphical work, and in attaining the results which Mr. McEntee gives us.

Reducing to Mathematics.

I am sorry Prof. McDermott is not here this morning, as he is more familiar with this subject, but I have had some correspondence with Prof. McMahon, of Cornell University, who has gone into the subject, originally in connection with some investigations having to do with electricity, but he has developed a method by which he is able to obtain mathematical expressions for stream formulae,—the work is not complete yet, but practically completed, and I think when his work is completed we will be able to do the work, which has been done graphically hitherto by mathematics, with perhaps one-tenth of the labor, and I think it is quite possible that that will be found to be of great value in dealing with propeller blades, for instance. The entire edge of the propeller blade is now made sharp, instead of round, and I think an investigation of the pressures on each side may lead to something well worth while.

Prof. H. C. Sadler: Prof. McEntee has dealt with this subject in two dimensions, but it occurred to me that the general results might apply quite well in case of a shape which, instead of taking the water line, applied it to a series of diagonals, that is, in general the conclusions would probably be about the same. It is interesting to note that the conclusions that he has arrived at are practically those we obtain in experimental tanks,—as Mr. Taylor has shown in his paper today, that you can get the water line too fine forward. I would like to draw Mr. McEntee's attention to some work by Herr Ahlborn, published in the Schiffbaudtechnischen Gessellschaft for 1909 in Germany—I do not know whether Mr. Taylor is familiar with his work also, he has been doing a good deal of work on the flow of water past solids, and he introduces some light seed into the water, so as to enable him to photograph the flow around the adjacent objects. In some of these photographs it is very remarkable the way the eddies form, for instance, a stream line will take some such form as that (illustrated on blackboard), with quite a marked eddy in the middle of this particular part. They are very instructive photographs, and I think throw a good deal of light on what happens when water flows around a boat. In some cases it appears as if this eddy had no right to exist there, but a photograph shows it up very clearly. These are given in a large volume of the Schiffbautechnischen Gesellschaft which shows some work on planes both moving longitudinally with the water and normal to the spiral, and the form of the eddies is very prettily shown.

Adjournment was then taken for luncheon.

Application of Electricity to Propulsion of Naval Vessels.

PRESIDENT Taylor called the afternoon session to order promptly at 2 o'clock. The first paper presented was entitled "Application of Electricity to Propulsion of Naval Vessels," by W. L. R. Emmet. This paper was an extremely valuable one and further attention will be paid to it by the REVIEW later. The figures and statements give in the paper for the electric propulsion of battleships are not mere theories, based upon supposed possibilities but in all essentials are accomplished facts. The plans are actual designs worked out in every significant detail which might be and, if opportunity offered, would be, contracted for and fully guaranteed. Two plans are outlined—a combination drive of a low pressure turbine and an electric motor upon each pro-

peller shaft; and an electric drive wholly by electric motors.

Discussion of Mr. Emmet's Paper.

W. Irving Babcock: The very interesting and carefully worked out paper to which we have just listened is one of the most important and valuable which has been presented to the society in a long time. It is hardly too much to say that it is epoch making and certainly it will furnish food for the most careful thought to every member of this society who is interested in the propulsion of ships—and not naval ships alone. Mr. Emmet's position and reputation, as well as that of the great electric company with which he is associated, lend especial force to his statement that that company stands ready today to make contracts along the lines here described and to fully guarantee the results indicated.

Between the two methods of propulsion described in the paper, there will doubtless be little difference of opinion as to which is preferable. The advantages of the electric drive, in simplicity and lightness, are manifest. Probably the saving in weight over the straight turbine equipment is the feature that will surprise the naval architect the most, but we can only assume that Mr. Emmet knows what he is talking about. In the case of the Chicago fireboats referred to in the paper, which were built from my design and described in Mr. West's paper last year, the question of weights was not important, but in a general way I might say that there was very little difference between the weight of the electric drive equipment and what would have been required for the simple double cyclinder steam engines that would otherwise have been used.

Great Ease in Handling.

Mr. Emmet is quite correct in stating that the performance of the electrical part of the installation on those boats has been simple and efficient in every way and probably there are no other boats in the world which can approach them in ease of handling and maneuvering in crowded quarters. This brings up a point which is not referred to in the paper but which, especially for naval vessels, is most important, and that is the possibility and practicability of handling the screws directly from the bridge, pilot house or conning tower without the necessity of bells or signals to the engine room or any occasion for the intervention of the engineer in any way. Misunderstanding of signals between the captain and engineer has been a fruitful cause of accidents in the past and doubtless will always be so. At this very moment the great traffic between Lake Superior and the lower lakes is almost at a standstill because of the wrecking of a gate in one of the canal locks from this cause, and this is the second time this season that that has happened, the Canadian lock having been similarly put out of commission for some days a few months ago. One hundred and fifty steel ships of the largest class are anchored above the canal now, waiting to get through, with over a million tons of cargo on board. With this electrical drive, operated by controllers immediately under the hand of the captain, all danger of this kind is absolutely avoided, for the engineer cannot misunderstand a signal that is not given at all.

By this elimination of signals from bridge to engine room, much time is saved also in operating the crews and this must be a valuable feature in naval vessels, either during the exigencies of battle or during fleet evolutions, especially in case of the sudden descent of fog or thick weather.

I fear, Mr. Chairman, that my remarks are becoming extended, and I will close by again expressing my appreciation of the great value of a paper which the society should be proud to have on its records.

Greater Cost an Objection.

Ernest H. B. Anderson: This paper is of special interest to me, because I am one of the men who looked into this proposed electric propulsion about three years ago, with the Parsons Steam Turbine Co., and the final conclusion that Mr. Parsons and the leading officials of the company came to, after making a great many designs and preparing estimates, was as follows: The first disadvantage of the scheme was that the total weight of the turbo-generators and the motors became prohibitive; secondly, there was great difficulty in finding a suitable motor that had a large variation in speed, to meet the conditions of marine service, and the third objection was that the cost of the completed installation was very much greater than that of a twin screw reciprocating set, or even an all-turbine arrangement of machinery.

With regard to the paper itself, and the combined drive in particular I would like to discuss the following points: I see that at speeds from 12 to 15 knots only one generator is in use and the steam from that generator is passed directly into the condenser, and the low pressure turbines are not used at all. Now, that means that you have two large pipes for exhaust of somewhere around 48 or 50 in. diameter, and it will be necessary to fix valves upon these pipes, so that at full power the steam can be passed from the generator into the low pressure turbine. Well, a battleship does most of her work at cruising speed, around 12, 13 or 14 knots, and the ship is not used at full power a great deal. Therefore, when cruising, both these low pressure turbines are going to get quite cold, as they are directly connected to the condenser. So that if an order came to reverse the engine suddenly, I think they would have great difficulty in starting the turbines, for the reason that the engines would quite cold and cause trouble to the blading.

Regarding Electric Drive.

Another thing, I think thrust blocks of the usual marine type, will need to be fitted, as there will be no balance between the steam going to the turbine and the propeller as the turbines are shut off. Then, if the turbines are to be kept in working order, in the other room, it will be necessary to keep a vacuum on the condenser and the circulating pumps running, so that the thing can be started right away and not have a shut down.

Now, regarding the electric drive, I am not in a position to discuss the design of the motors, but I think Mr. Emmet is much too optimistic in his estimated water consumptions, chiefly for this reason, that one of the latest battleships, that has just completed trials, at full power for a speed of about 21 knots, required around 30,000 shaft horsepower, and the ship's displacement was 20,000 tons. Now, we have a very similar proposition before us here, and the displacement of the ship is 26,000 tons, but the shaft horsepower is based on 26,000. I think it should be nearer 36,000, to give somewhere near the same results as the ship that has actually been tried. This, of course, will bring down the cruising rate a great deal.

I think the curves made, comparing the electric propulsion with the Parsons turbine, are hardly quite fair to the Parsons turbine, since the conditions are so entirely different. In the electric drive you are working

with steam at the end throttle valves, at 260 pounds, with 50 degrees superheat. In the Parsons turbine ship the boiler pressure is about 210 pounds, and the pressure at the engine stop valve is a minimum of 175 pounds, with no superheat. This condition is very much in favor really of the Parsons turbine ship, as everything is not worked up to the high pressure that it is in the other case.

Mr. Emmet makes the statement that the four propellers of the Parsons turbine ship interfere with each other. We know from experience, from the results of all ships that have been tried and are in service, that one propeller does not interfere with the other, and they are so arranged that each propeller has solid water fed to it.

Comparative Weights.

With regard to the comparative weights, I see that the weights are given in the electric drive for two turbines without bearings. I think there should be a weight given for the bearings. If not, it will also be seen further that no allowance has been given for the thrust block weight. That is an essential in the engines, and in a ship of this type will amount to a good deal.

Now, the last point is this—I think a better comparison could have been made by taking a proposition fitted with Curtis turbines working under the same conditions as the revolutions of the two propositions, that is the Curtis turbine and the electric drive, and the conditions would have been practically the same, whereas with the schemes under discussion, the conditions are entirely different.

One other point, and that is that the total cost has not been given in this case, but in the bids for the combined scheme that was submitted to the government at the time of opening the battleship bids, the difference in cost between the lowest Parsons bid that was submitted, and the bid for this combined drive, was about $645,000, which is pretty considerable.

Alternative Method of Electric Drive.

John Reid: This is a paper which interests me rather closely, in connection with some of my own work, and I only rise to discuss it because I can show the members an alternative method of electrical drive, which has been introduced on the other side, and which is attaining considerable importance.

I am satisfied that Mr. Emmet has brought up a subject here which will introduce an entirely new epoch in marine engineering, and that it will go on the records of this society as introducing such a new era, which will bring in tremendous changes in all parts of marine engineering. One noticeable point in the paper as presented, is that Mr. Emmet has assumed that no one else has done work on these lines, but that his company has been able to bring forward a proposition which will bring about successful results. I do not think you will find in this world, in a great movement like this, that but one man or one firm is on the ground alone, and I will show you in as few words as I can, and at as small an expense of time as possible, a Mavor spinning motor, which I think is as far advanced as Mr. Emmet's motor or the General Electric Co.'s motor. I am not an electrical engineer, and I will ask Mr. Emmet and the electrical engineers present to correct me if I make mistakes.

The Mavor System.

This is an alternating current motor (illustrating on the blackboard), of which I will only draw a part, you have the rotors here. You have the stator surrounding it. Now, in the Mavor system we introduce what is called a spinner which goes around the rotor, that is a floating spinner or ring, and I can best describe the thing by reading to you a few lines from a paper which Mr. Mavor read on the subject about two years ago. This is the rotor, R, and this is the spinner or regulating motor, and this is the stator. He says in his paper: "The machine is thus two motors concentrically arranged round the common axis. The three speeds which may be described as prime, secondary and tertiary, are attained without loss of efficiency, but if intermediate speeds are desired they are obtained by a slipping brake or external resistance in each case equally with a constant loss of efficiency. This loss of efficiency is very small, and is less than the loss involved where series wound continuous current motors are used for speed variations; or intermediate speeds may be obtained by providing a separate supply of current to the external motor and changing its speed by change of periodicity of the supply.

"The electric current is delivered from an outside source to the primary windings of the stator and spinner respectively, passing in each case through a simple reversing switch which determines the direction of rotation. The stator circuit also supplies a magnet, which, when no current is passing, releases a brake which brings and keeps the spinner at rest. When current is passing, the magnet lifts the brake and leaves the spinner free to revolve.

All the Speed Variations.

"The three-speed motor provides a means of obtaining all the speed variations which are required on a ship. The intermediate speeds between the three normal speeds of the motor are obtained by variations in the speed of the generating plant, which are within the limits of practicability and economy. Each propeller shaft is provided with a directly connected motor on which there is co-axially superimposed a second motor for speed regulation. The regulating motor is mechanically connected and magnetically entrained with the first in such a manner that the speed variation may be effected as follows:

"For slow speed, by running the regulating motor in the reverse direction to the direct connected motor; for intermediate speed, by running the direct connected motor alone, the regulating motor being stopped; for full speed, by running the regulating motor in the same direction as the direct connected motor.

"This arrangement requires no spur wheels or friction gearing. Each motor is controlled by a simple reversing switch without any other mechanism, and there are no power wasting devices."

That is to say, you will get all the changes of speed necessary in all classes of engines and propulsion without resistance or speed reduction devices. You can get the reverse almost instantaneously, with a big range of speed changes. While some may imagine that the introduction of the spinner is an added complication, in practice it works out pretty easily. Now, this scheme has been before practical engineers for some time, and is going to be tested on a large scale.

Too Big a Jump.

I think that one of the most serious difficulties which Mr. Emmet is undertaking to overcome, is to jump from a Chicago fire boat, of a few hundred horsepower, to a battleship at one leap. I do not believe that can be done. I do not believe it can be done, no matter how you figure or how you plan, or what you calculate —and I do not believe without a proper test, up to a few thousand

horsepower, that the data on which this paper is based can be considered absolute in any sense of the word. We know what happens, as practical men, when you make a bold leap and start from an insufficient basis—you generally land in a mess.

Internal Combustion Engine.

Personally, I have been trying to adopt the electric drive for a very peculiar cause—the limits of the vessel being fixed in size, we have to get increased capacity by decreased machinery weight, and also fuel weight, and I think one great advantage of the electric propulsion scheme will be this—that you will be able by it to introduce very simple internal combustion engines for ship propulsion, that is, absolutely linked to this electrical arrangement, but I do not think the internal combustion engine can be introduced without the introduction of electricity for reversing or changing the speed. We have tried it the other way, not to the extent of including the engine, but we found we could get no satisfactory means for reversing the engine or grading the speed, no satisfactory means of gearing would get rid of the difficulty of the gas engine, or running at one speed for the best results.

Mr. Emmet has passed rather lightly over the question of the propellers. I believe the propeller will determine the success of his system. I quite agree with him that a new propeller will probably be evolved to suit the new conditions, and it will not be a propeller for the present reciprocating machinery, nor a propeller for the turbine, but one in between, but I think in a high speed boat the best results can be got by using this electric arrangement to gear down from a small propeller to a large diameter propeller with a slow speed of revolution.

I do not want to put Mr. Anderson right, because he knows more about Mr. Parsons than I know, but I will say this method has the backing of Mr. Parsons, and is receiving his consideration, and he is still interested in it. It has come before the British admiralty, and has also been investigated by the United States navy, so that I hope something practical will be heard about it.

President Taylor: Mr. Dobson, do you care to say anything about the subject under consideration?

Mr. William A. Dobson.

William A. Dobson: I should be glad to discuss the paper, but I do not really feel qualified to do so. The subject is one of great interest. It is of great interest to me, and I have been especially interested in the tables of velocity given for the electric drive, and I have no doubt that the statement on page seven has a good deal to do with that, the form of resistance has been developed by experiment, and I think we will be glad to learn something about that. There are so many others better qualified to speak on the subject, that I prefer they should speak rather than myself.

President Taylor: Mr. Magoun, will you discuss the subject?

Henry A. Magoun: I should be glad to say something, but unfortunately I have not been able to look into the matter.

President Taylor: These battleship builders are very modest. Mr. Edwards?

Mr. Charles B. Edwards.

Charles B. Edwards: I do not think I can add very much, gentlemen, to the remarks that have been made. There are one or two statements brought out I should like to correct, one in relation to the brake horsepower developed on the trial of the North Dakota, to which reference was made. That amounted to a little over 41,000 H. P. at 21.6 knots, which I believe has been variously quoted as high as 35,000 H. P.

In regard to the reversing of the turbines while cold, we have never experienced any trouble from that cause. The reversing portion of the turbine is running, of course, under low vacuum, perhaps 28 inches, and no difficulty has been experienced with the blading in admitting live steam suddenly to the reversing turbine. That has been done repeatedly. While in the early stages of the development we had some fear that there might be trouble yet practical experience shows there has been no difficulty in that respect. Mr. Emmet's paper is certainly very interesting and indicates a great step in advance in marine propulsion. I do not think there is anything more I can add.

Mr. Ernest H. B. Anderson.

Ernest H. B. Anderson: In the figures I gave for the North Dakota, I based them on the published reports, which gave 33,800 shaft horsepower for a speed of 21.8 knots, and which, for a corresponding speed of 21 knots, would be approximately 30,000 shaft horsepower.

As to the other point, about putting steam into the astern turbines when cold. In this combination drive, the case is quite different, because the ahead turbine has not been used at all, it is shut down, so that the whole thing is under vacuum at a temperature between 90 and 100 degrees, and it is bound to get cold, even into the other shaft, and that is where I think there would be danger in doing that to the astern turbine. Of course, if the ahead turbine had been working right along all the time, then the astern turbine has a good chance of keeping warm, but in this case it is quite different.

One other point I forgot to mention—when using the one generator, with the turbines shut off, at 12 or 13 knots, you are carrying about with you 330 tons all the time in your engine room, doing no work, but always, to my mind in some danger of damage happening, if for any reason they put steam into the reverse nozzles and the other way would be to make the motors reversible so that there is no need to use the turbine.

Mr. Emmet: I would like to ask Mr. Anderson a question. He asked about cost. I will give him some idea of the cost of my device, if he will give me some ideas of the cost of his. I do not know the cost of the Parsons turbine equipment, and will be interested in knowing something about it.

Mr. Anderson: I am sorry that I do not have any idea of the cost, for the reason it is not up to me, but up to the contractors who make the turbines,—my work is more in giving the estimates of weight and that sort of thing, and working up the design. But as to the actual cost of building, I know nothing about it.

Electric Drive Promises Much.

Capt. W. Hovgaard: I think the electric drive seems to promise a great deal for us in our warships, especially in battleships, and there is one point, which has already been touched on, which I desire further to bring to your notice, and that is the direct control from the bridge. That is a point which I think is very important, and in several other ways we are working in the direction of controlling everything in the battleship in one central station, from the conning tower. There has been taken out a patent by an English engineer for controlling the turbines from the bridge, and I suppose the electric motors would lend themselves still

better to such a joint control than the turbine. That would be very advantageous.

President Taylor: Mr. McFarland, we would be glad to hear from you on this subject.

W. M. McFarland: I am in the same position as a good many of the other gentlemen, Mr. Chiarman. I did see the paper before I came here, but have not had time to read it carefully, and knowing Mr. Emmet's eminent ability, I would naturally assume that anything he would put forward would be correct, so that I have no comments to make on the paper at all.

President Taylor: This subject opens up a wide field and I trust you gentlemen will take advantage of this opportunity for discussion. If there is any gentleman present who will say something, we will be glad to hear from him.

Mr. E. A. Sperry.

E. A. Sperry: An engineering friend of mine took exception to one sentence on page four of Mr. Emmet's paper, where the following statement is made: "These results it will accomplish without the introduction of any feature which can be considered problematical," illustrating that by land turbines and land practice. My friend also called my attention to the figures on plates 1 and 5, and the excessive speed there indicated. The remark was made that these large masses running at very high speeds. would introduce a certain gyroscopic phenomenon, which might become very problematical. I wish to say that this phenomenon is one that I have investigated somewhat, and I would like to add my testimony that the remark made by Mr. Emmet in his paper is correct, the working of the turbines in this way does not introduce any gyroscopic motion, no matter what speed or weight are involved, so that I think this clause has been introduced advisedly.

Mr. Parker H. Kimball.

Parker H. Kimball: I wish to ask Mr. Emmet in reference to page four, where he says: "The voltage is low and the arrangement of generator and motor constitutes the simplest known means of electrical power transmission. With such apparatus insulation trouble or mechanical trouble is practically unknown, and there is no other form of mechanism which can accomplish such results with equal simplicity and certainty." I ask what is the maximum voltage used on the combination drive? It is stated for the full electric, but not for the combination; also, what are the approximate frequencies used?

President Taylor: Is there any other gentleman who desires to discuss the paper? If not, I will ask Mr. Emmet to close the discussion.

Handling From the Bridge.

Mr. Emmet: The first subject raised is that of handling from the bridge. I will say that this particular scheme, that this paper mentions, offers no special advantage for handling from the bridge, because of the result of interconnection of generator unit and the motors. The straight Curtis drive could be very easily handled from the bridge, just as we handle it from our speed generators, more easily than to have it handled from the engine room, and this could also be handled from the bridge, since it is a Curtis turbine, but to make these changes for reversing and all that, it would be necessary to provide means for shutting off the steam, and while naturally that would be taken care of by the valve—you see in the Curtis turbine we use individual valves for admission, these valves are controlled by a cam shaft, which is moved by steam or hydraulic means, generally by steam. This opening or closing of valves can be worked by any engine room telegraph method. It would be easy, as we do in the controlling of a locomotive, to work all the switches necessary by electric means. In point of fact, the propulsion of a ship, is about equivalent to the propulsion and operation necessary in the driving of one of the New York Central locomotives, and 40 or 50 of them are doing daily service up and down the road,—all the high resistance and switch mechanism is entirely away from the engineer, and he pulls the lever one way or the other, and it might as well be a mile away as 10 ft. away, the result is the same. He does not know what is happening when he pulls the lever, he knows the machine turns around and goes the other way. That could be accomplished in this apparatus and could be accomplished in the straight Curtis drive, with more simplicity, and with very little difficulty it could be accomplished in the Parsons drive.

Variations in Speed.

As to the variation in speed—there is one thing about this which some of you may not have understood—this method I am proposing is not a means of electrical speed variation. Everything remains fixed. We do not make any gradations of speed by electrical means. The only speed change made is in changing the number of poles in the motor for certain low speed conditions, namely, the cruising speed of the ship. We make an adaptation for the cruising conditions, and that adaptation being made, the ship can be brought to the higher or slowest speed permissible in the apparatus without any change of connection. If you reach the limit of that particular point and want to go to higher speeds, then you make a new adjustment, and then we have another arrangement which enables you to go on up in speed.

I cannot give you a very good idea as to the cost of this apparatus, but I can say that we build turbines, have built a large number of turbines of various sizes. Our larger turbines weigh approximately the same as the generators which they drive, not much difference, a little bit more perhaps. The cost of building these turbines which are of the same general type as this is not very different per pound from that of the generators which they drive. Our turbines are similar in construction to the Curtis marine turbines, that is, in the general character of their construction, and therefore it is easy to see that pound for pound my combination is not very much more expensive to build than straight turbine drive. I will say, roughly, that some of our large turbine apparatus, a great deal of it, I think, throughout the country, is sold somewhere in the neighborhood of 20 cents a pound, and the weight of this has been given, and you can figure up somewhere around what it might cost. However, this being a special thing, and there being a good deal of special adaptation in connection with it, it might run a good deal higher—I have not figured what it would come to now, but it would probably give you a wrong idea to make it look cheaper than it would be, because it is our aim to make it just cheap enough.

Starting with Turbine Cold.

Mr. Anderson raised the question of the valves in connection with that combination drive. Of course, in that scheme we would use for admission separate individual valves to cover certain small groups of nozzles. We also might use large throttle valves as well. If the ship was standing still, and that part used, the smaller valves would be closed.

Mr. Anderson raised the question about the difficulty of starting with that turbine in a cold state. The conditions that actually exist would be these—the turbine would be cool from one end to another, it would be filled with vecuum pressure from one end to the other in all stages, and it would be entirely cold, it would be acting simply the part of a condenser. We keep the steam sealed on the idle ends of all the apparatus and keep the air from getting in. That is a certain condition of loss which has been calculated—the difficulty of turning hot steam into the turbine successfully with the type proposed. In our power station at Schenectady we have five turbines standing idle all the time, two 9,000 kw. and the others 15,000 kw., and we run with water power from the Hudson river, and sometimes the water power fails, and we immediately pull the throttles wide open and throw the machines on the governors and synchronize them and the time of cutting in is the time in synchronizing them. That is done with Curtis turbines everywhere, and there is no reason why you should not blow all the hot steam into them you want to, and there is no possibility, from that course, of any practical difficulty. That applies to Mr. Curtis's marine turbine as well as it does to ours, if they are built right.

Question of Thrust.

The question of thrust is just exactly the same in their scheme as it would be in a direct turbine driven at the same speed. It is a question of putting thrust collars on the shaft in the ordinary way. These thrust collars in my drawing, I have not taken under consideration as to their weight, as in my drawings. I have shown them as they are shown in the Fore River design, in point of fact I think they are exactly like those on the North Dakota, and they have not given us any trouble.

As to the question of shaft horsepower assumed—that is in accordance with estimates which I derived from various sources of comparison. I did not undertake to pass at all upon the practicability of the efficiencies of power required for these ships, I simply took what is said in that respect, made various comparisons, particularly with the Delaware and North Dakota, and showed that my assumptions are not seriously wrong.

Steam Pressure.

The question of steam pressure, which Mr. Anderson brought up is a very important one, because while increase of steam pressures are our only means of increasing the theoretical economy of the steam engine, by increasing the steam pressure we work in a wider range with available energy, the turbine provides for the low pressure end to go to its extreme, and our limit there is the temperature. The limit at the other end is not the temperature, because we can use high temperatures with impunity, as we do with superheat. But pressure is the practical limit. One of the advantages of the type of turbine I am proposing for this is that we can use any pressure.

Question of Weights.

I think in the case of Mr. Anderson, it is not only a question of not wanting to, but not being able to. If the Parsons turbine could use high pressures advantageously, they would undoubtedly avail themselves of all the increased economy incidental thereto, but it is due to the fact that they fill the inner spaces with high pressure. Of course, turbines using low pressures are sometimes more convenient, and a turbine which will produce the same result at lower pressures, is more desirable than one which will take high pressures to produce it. Of course, the one with the higher pressures is working in the larger field, and has that possibility.

Now, as to the question of weights, I have carefully eliminated, as well as I could, all weights that could not be compared in this matter. The list of weights which I got from the navy department concerning this fast drive they designed, which may be different from that as actually built, gave these weights segregated in a good deal of detail, and gave the weights for shafts and bearings, and valves and pipe, and various things, all of which I struck out. I took simply the weight of the main turbines, and, as against those, I have taken the weight of our turbine alone, and compared generator and motors. Now, our turbine is lighter and smaller then theirs—all of our turbine motors and generators are lighter and smaller in dimensions than theirs. The pillow blocks are smaller and must necessarily weigh less, with equally good construction. Furthermore, the structures on which they must be mounted can be made lighter. All of these things have been left out of the comparison, and I think if the bearings are included, it would be decidedly in my favor. Then the most important thing I have left out is the question of piping. If you will look at my figures you will see what the piping means in the Parsons sheet. In the actual drawing of that sheet—I did not have time to trace them, although they would have made a beautiful illustration for my own paper—the engine room space is a tangle of pipes, and large pipes, to connect the stages together, and all of these pipes were radiating good heat, and that heat was carried away, and when it is carried away it cannot be used to drive the ship, and in my apparatus that loss is saved.

From Fireboat to Battleship.

The question has been raised whether in such matters we could make such a jump from a fire boat to a battleship. My experience in engineering has shown me that the very best of the greatest successes have been attained by just such jumps. A man wants to be sure he is right, and then he wants to go ahead. The longer he jumps the higher he can put his aim, the more useful the accomplishment. I went to Chicago in the year 1900, when the largest turbine in the world was 1,000 kw., and the largest we built was 500 kw., and that only one, and not too efficient, and I made a contract for three 5,000 kw. units, and they began to deliver power about six months later and have been doing it ever since. You can go right through the science of engineering and find just the same things. When big things have to be done, they must be done on the strength of calculations and demonstrated possibilities. Take, for example, today they are rolling steel rails with motors such as I have proposed for the ships. Until six months ago they never rolled rails by motors. Rolling rails is one of the biggest mechanical jobs in the world. The value of the material handled is so great that the cost of lost time is enormous. The value of the apparatus is nothing compared with the loss or gaining of time. If you go to Gary and see these big rolls running by electric motors, and know it was done on paper before it was done mechanically, you can understand that the battleship job is a small undertaking, especially as the apparatus could be taken out and replaced by turbine machinery if it did not work.

As to what Mr. Sperry said, the gyroscopic action in this case need not be considered at all. I think there will be some gyroscopic motion produced, but the calculations show it would not affect the bearings at all.

As to the question of voltage and

frequency I have forgotten the voltage proposed on the combination drive, but I think it was about 2,000, and on the other 2,300; in both cases the frequency at the maximum is approximately 60 cycles. The reason for the adoption of a voltage of 2,300 is on account of the convenience in the switches and windings. If you use a lower voltage the change of connections becomes very heavy, and you must use big switches to handle them, but in this case it is simpler to use such voltage as I have stated, because it is simple both for the induction motor and the generator. What we have done is to compare carefully the number of factors in both, and arranged and tested one and the other, until we got the best plans and got the best conditions in the generator and induction motor. That gives a switch at 1,500 amperes. We use a switch with big toggle brushes, brushes made of that shape (illustrating on the blackboard) that are bushed in to make an insulating handle. This is a mica insulator here, this is all insulation, here is the toggle. A toggle of small size applies great pressure to this switch, and it makes a method of conduction just exactly as good as if the bars were soldered up and riveted perfectly. It is not a switch suitable to open under load, but is absolutely positive in its closing.

President Taylor: Mr. Emmet's paper has certainly given you all food for thought, and whether you all agree with him in his conclusions or not, there will be a great benefit accrue to our industry from the reading of it.

Weights a Surprise.

Mr. Emmet: Mr. President, there is one more remark I desire to make. The question of weight has been emphasized, and I want to speak about that. The weights have been a surprise to me. The apparatus is designed with a view to keeping it light, although the mechanical construction of the turbine is just such as we would use and are using actually in the land service. We have made recently within a few days a very large proposition. The turbine on which we made that proposition was almost identically the same as this, same speed and same capacity. It is outside of the country, but we expect to close the contract for it. The actual calculated weight on that and this are identical, the same number of stages, speed, etc. The weight of generators and motors and all such things are questions of ventilation, carrying away the heat, and that is a very important problem in connection with this application of electricity, which ought to have been touched on in this paper more fully. The proposition in this case is to put in a special additional connection for air, taking air down from ventilators and leading it directly to the apparatus and then supplying to your generator and motor blowers, air-impelling devices which will force a large amount of outdoor air through them. The fact that we are using out-door air is in our favor. In fact, we use a large amount, and it enables us to make the apparatus somewhat smaller. The thermal conditions are not any worse aboard ship than they are in many existing installations that are successful. That has been one of the points of special design, by which we gain in weight.

No Claim of Novelty.

Another thing which should be cited is this—that this apparatus is designed on a peak load basis, this high-speed condition of a battleship corresponds to the occasional extreme peak on some electrical plants on land, and this turbine gives these conditions. The turbine which I have described in my paper is run at what we consider a heavy overload. That turbine, instead of being rated at 11,000 kw., would ordinarily be rated approximately at 8,000 kw., and this is an overload condition, but it is an overload condition which the turbine can stand indefinitely, with a considerable temperature rise and a large amount of air passing through. Those conditions, all of them, are entirely safe. The distributive character of the winding is such that the whole mass of the apparatus will heat up together, and there will be no local heating of parts which will endanger the ship at all.

Of course, it has been said that I claim novelty in this thing. I do not. I tried to disclaim it in the beginning of the paper. There is nothing in this paper which is not a matter of general knowledge as far as principle is concerned. I have made a few possible inventions in connection with these combinations which may or may not be new. The whole thing is the skill with which it is designed and worked out, and I claim that these are actual designs, and that they are right, and I think that they are right, and the only novelty I claim is that I have taken the trouble to work out real designs, whereas, others have discussed generalities and in discussing weights as generalities you are apt to mislead yourselves and put in something which seems to be an operative condition or which turns you away from it, and that is generally not the limitation at all.

The Problem of Resistance.

One of the important points considered in this paper is the question of resistance. One of the great problems in getting torque out of a large motor is to dispose of the energy. When an induction motor stands still it acts simply as a transformer. Its primary and secondary are stationary to each other, and any current you put into it is transferred directly from one to the other. If it is to produce any torque and do any work, it must be dissipated in the secondary. If we simply allow current to go in without absorbing it by resistance, the current simply dissipates itself and no work is done, and you are simply magnetizing current and the total loss is the heating due to the hysteresis of the iron and the heating of the conductors. To get torque, we must have work done, and this work must be thrown away. The only practical way of dissipating so large an amount of energy, which is virtually the whole output of the generator, is to put it into water and throw the water away, nothing will use up the heat faster. If we had to cool the resistance by pumping air we would have the cold air apparatus ten times as big as the other apparatus.

When I first considered this question, I saw that this resistance business became a large proposition, and I turned away from it at first on that account, but I have since made a resistance and I have dissipated energy into small spaces on quite a large scale, and know exactly what I can do.

New Metal Talorite.

I will show you what that device is. (Drawing on blackboard.) This is a U made of drain tile pipe. One of our engineers about two years ago developed a kind of metal which we call talorite, which is a metal we use for resistances. It has the peculiarity of having a very high resistance, a very constant resistance, about 65 times that of copper. It also has the peculiarity of being entirely non-corrosive. A small piece, the size of a cambric needle, exposed in a sal-ammoniac solution together with the cambric needle showed no sign of diminution in weight, whereas the needle was entirely gone. Furthermore, it is almost proof against electrolysis, and it occurred to me, therefore, that this was something we could use in water resistance, because the trouble with water resistances is that they destroy themselves and there is a large

corrosion on the structure. I put a ¼-in. rod of this material in like that (illustrating on blackboard), then I carried another heavy cable through here, and out here. Now, I submerged the whole thing in a bath of water, simply so it could have a natural circulation or connection, as many automobile cooling devices. Into a coil smaller than what I have drawn, slightly shorter, I dissipated without any trouble 360 kw. continuously, and after it came out it was just exactly as good, no rusting or deterioration or anything else. That means that in these battleships I could make three barrels, as high as the blackboard, and connect them to the circulating system, so that the water would course through them, and take care of this power indefinitely. The whole thing could be equipped with rubber gaskets, which could be taken apart, so that an examination could be made in a few minutes.

Rail Mills and Locomotives.

Henry A. Magoun: Since I came into the hall I have heard a number of things, and among them the question of weights. I have no exact figures, but I would say at the time the contracts were taken for the Wyoming and the Wisconsin, that the rough weights as given to us were very considerably above what we were using. As I remember, they would almost make it prohibitive to use this gear.

Now, there are one or two other things. I have heard this arrangement compared to the electric locomotive, and also to a rail mill, and there seems to be no consideration given to the fact that it is to be used on a vessel. There is no comparison, particularly, between a battleship and an electric locomotive, and the question of handling this arrangement with switches from the pilot house appears to me rather ridiculous, because until you can handle your steam by a switch you cannot handle this arrangement by a switch. The fire room is as important as the engine room.

I also heard a comparison with rail mills. I am familiar with the rail mills, and I must say that I see no useful comparison whatever. In the case of the vessel, the steam is generated on the vessel and many things have to be taken into consideration besides the mere motor that runs a rail mill. I think the subject should be considered entirely from the standpoint of the vessel, and the use of the apparatus on locomotives or in rail mills is no proper basis for a comparison.

E. A. Stevens Jr.: Mr. Emmet speaks of the comparatively low voltage used in the transmission, some 2,300 volts. To electrical engineers building high-tension lines and transmitting current several miles away by a high-tension line of 16,000 to 20,000 volts, 2,300 volts may seem somewhat low, but to men accustomed to ships, using a voltage of 110, 2,300 volts seems extraordinarily high, and all who have been to sea know how damp it gets, especially at night, and when you get up in the morning and put on your clothes, they are about as wet as if you had been on deck in a downpour. In a condition like that, and using a voltage of 2,300, it seems to me there would be great danger of having short circuits in the electrical apparatus.

President Taylor: These remarks are somewhat out of order, but the paper was so interesting that we will ask Mr. Emmet to reply.

Mr. Emmet's Conclusion.

Mr. Emmet: My comparison of the turbine to be used on a battleship with rail mills and locomotives was simply in reply to the criticism that such jumps could not be made. I was simply giving it, in view of the jumps which have been made successfully. I do not think the conditions are similar, except that the motor happened to be the same. The services in a rail mill vary considerably, and are very heavy on the induction motor. The place is very dirty, and it proves the reliability of that particular kind of apparatus.

So far as the voltage is concerned, this voltage could be made anything, I could connect the circuit of the apparatus in parallel and run down to 100 volts, if I wanted to, but it would not be good engineering to do it. The dampness which has been mentioned would have no effect whatever on the insulation put on the apparatus. It is not like equipping the whole ship with 2,300 volts, it is simply two pieces of apparatus side by side, connected together by two cables which are in sight, and no matter how damp it is, it is easy to keep electric apparatus dry simply by a question of temperature and ventilation, warming it by electrical current, if you please, but it would not be necessary in this case; we could put a waterproof insulation on the entire apparatus and dampness would not affect it. We have had motors operating at high voltage that had been saturated. I started two generators in Washington that had half the insulation burned off, and then submerged, and we cleaned them up, and in an hour or two had them running again. This voltage is adopted because it is simple and direct, and there is no question whatever about continuity and reliability even under conditions of moisture.

Producer Gas Boat Marenging

H. L. Aldrich's paper, "The Producer Gas Boat Marenging," was then read by its author. This paper gives the results of installing a producer gas plant in a 40-ft. power boat driven by a four-cylinder, four-cycle engine of the usual stock type. The boat made a round trip from New York to Albany on a consumption of 2.31 lbs. of coal per mile or 636 lbs. for 275 miles.

Discussion by Mr. Monteagle.

R. C. Monteagle: In looking over this paper it would appear that some important data are missing, the more important of which are the brake horsepower and the displacement of the boat. For a comparison of any value to be made in economy of fuel between the producer gas engine and any other type of motor, whether gasoline, kerosene, crude oil or steam, some standard of power must be adopted, and the brake horsepower as a unit is as easy to realize as any other. The expression, "economy of fuel," is a comparative one only, and when the author states, as he does on page 5, that the main question at issue in making these tests was that of economy, it is necessary to have all the data by which to determine such economy. Under ordinary conditions the engine of the Marenging using gasoline, for which it was designed, would develop say 40 H. P., at 400 R. P. M., and an assumed mean pressure in the cylinders of 75 lbs. per sq. in., which may be easily realized. With producer gas and a pressure of 90 lbs. as given, it would be fair to assume that a mean pressure of 60 lbs. could be realized with a gas 30 per cent leaner than that produced by gasoline. Figured at 400 revolutions, this gives approximately 32 H. P., and with an engine efficiency of 90 per cent this gives practically 29 B. H. P. The greatest fuel economy heretofore obtained from a producer gas engine of say 500 lbs. B. H. P. has been approximately 1 lb. of coal per B. H. P., and for an engine of 50 B. H. P. it approximates 1¼ lbs. of coal per B. H. P. As the author states that the engine installed in the Marenging is a stock gaso-

line engine, such an engine could not certainly give any better fuel economy than that. On page 5 it is stated that it was demonstrated that the boat could cover practically 900 miles on a ton of anthracite coal at a speed of 8 miles per hour. Then $\frac{900}{8} = 112.5$ hours running time. $\frac{2,240}{112.5} = 19.9$ lbs. of coal per hour and $\frac{19.9}{29} = 0.68$ lbs. of coal per B. H. P. hour. Taking the pounds of coal burned per hour on entire trip, as given in the table, viz., 15.32 lbs., we have $\frac{15.32}{29} = 0.52$ lbs. of coal per B. H. P. per hour. Taking even the larger value, it would seem from this result that an error of formidable magnitude has found its way into this paper. It would be difficult to believe that an engine of 40 H. P. built to use gasoline, and placed under service using producer gas could be made to give a better economy than 1½ lbs. of anthracite coal per B. H. P. per hour.

Mr. M. Lee Straub.

M. Lee Straub: As the designer of the producer in the Marenging, and the engineer who laid out the plant and operated the boat for almost a whole summer, I probably can answer the inquiry of the last speaker. The engine was 5¼ in. bore, 6 in. stroke, rated at 35 B. H. P. on gasoline, at 750 R. P. M. It would be impossible for that engine at 400 turns to develop better than 22 to 25 B. H. P. on gasoline. We did not take any indicator cards from the engine, because it was impossible, there was no connection for the indicator. The engine was installed in the boat in such manner that it would be impossible to insert a dynamometer between the engine and the propeller, and all we could assume was problematical—the mean effective pressures on producer gas. We tried to get 110 lbs. compression, but that was impossible in view of the construction of the valve chambers in the cylinder head. We found that we got about 90 to 95 lbs. compression, and that should give a mean effective pressure, at the speed at which we were running, of somewhere between 55 and 60 lbs. per sq. in. That would give us about 16 to 17 B. H. P. on the engine, of 400 to 425 R. P. M. I dare say if we had 32 H. P. in the hull, we would have made a speed of at least 12 miles an hour, but we did not have it. The boat was operated from last April until last month very successfully. The producer plant worked well, as other producer plants of similar design have worked before. The boat, as Mr. Aldrich has said, was brought out as an experiment, and Mr. Aldrich is to be commended on his activity in that regard. The producer was installed on the boat against my opinion, as I believed that a small motor boat is not the place for such an installation. The average motor boat owner has use for every square inch in the boat, and with ordinary precautions in the handling of gasoline, little or no danger should be had. The motor boat owner, as a rule, has no regard for the fuel cost in operation, and the only reason for the use of the producer, I believe, in motor boat work, is on account of safety. The producer plant is undoubtedly the most safe proposition that can be installed, there is nothing to explode or blow up, and for commercial boats, of large or small powers, there is no question of the economy to be derived from the insertion of such plants.

Take, for instance, the trip to Albany and return, last summer, if the figures given are correct, the cost of fuel was $1.59, at $5 per ton. I believe the possibilities for producer gas on marine work are coming to the fore very rapidly, and it will be only a few years when we shall see large installations made.

Mr. Henry Weston True.

Henry Weston True: (Communicated) There is very little in Mr. Aldrich's interesting paper to discuss, and he certainly deserves great credit for his enterprise. While no statement is made as to the horsepower, I would assume from the speed and dimensions of the boat that about 10 H. P. was developed. This is also borne out by the fuel consumption of about 15 lbs. per hour, as I have found by many tests that the fuel consumption to be expected in a plant of this size is about 1½ lbs. per B. H. P. hour. This comparatively large consumption of fuel is caused by the low efficiency of small engines on producer gas.

I find a great deal of interest in the gas producer for marine work, and I sincerely hope that its introduction for this purpose will not be delayed, as the stationary producer has been by the enormous prices for apparatus caused by stock promoting enterprise rather than legitimate engineering work. A gas producer is a very simple piece of machinery. It can be built by any boiler maker without special tools, and should be built as cheaply per horsepower as a boiler.

Adjournment was then taken for the day.

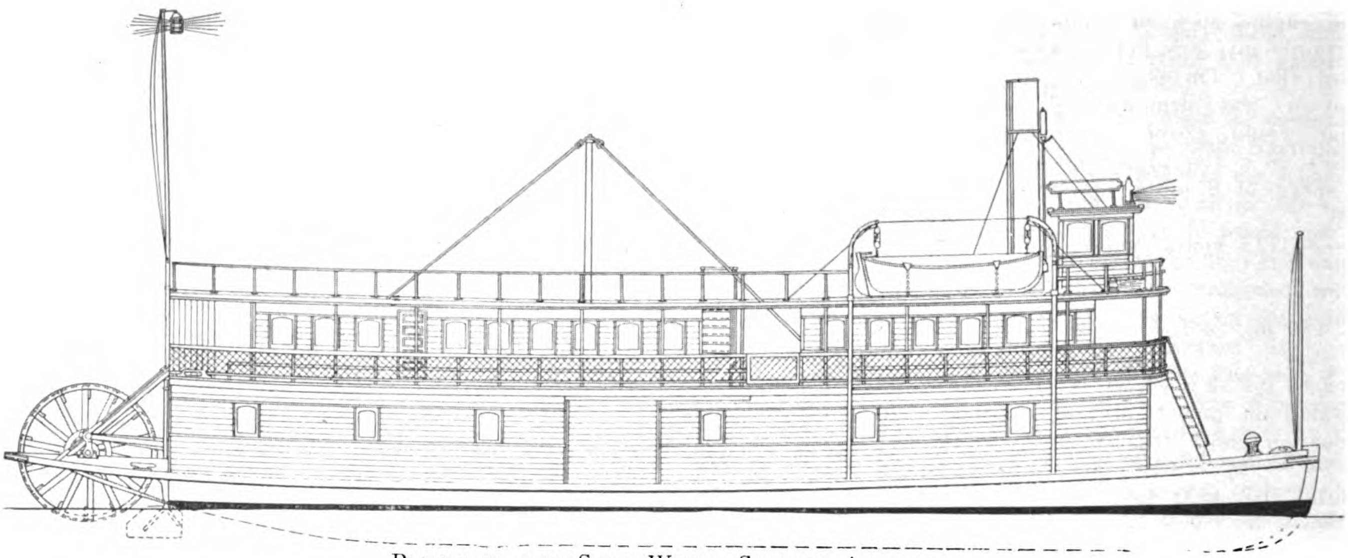
(To be Continued.)

TURBINES FOR CARGO BOATS.

Among the steamers now lying at Newcastle-on-Tyne is the steamship Vesperian, which is likely to excite a good deal of interest before long. This vessel was bought some time ago by the Parsons Marine Steam Turbine Co., with the intention of running her in the Spanish trade in connection with the important naval contracts secured by the Parsons company. She was sent on a Mediterranean round trip with a special staff of engineers on board, whose duty it was to make careful note of the vessel's speed and coal consumption. Having returned from this trip, her old reciprocating engines have been removed, and in their place specially designed slow-speed turbines have been substituted. She is now ready for sea, and it is understood that the special engine room staff will again be sent out with her, in order to take notes of her performances, and compare them with the results recorded by her reciprocating engines. In this way, valuable data will be collected, and the applicability of the turbine to cargo steamers will, it is thought, be proved or disproved, just as it turns out.

The new side-wheel steamer Three Rivers, which the Maryland Steel Co. is building for the Maryland, Delaware & Virginia Railway Co., at Sparrows Point, was successfully launched Saturday afternoon. There are still on the ways at Sparrows Point five large ships aggregating a total length of about 2,000 ft. They are the three combination freight and passenger ships for the American Hawaiian Steamship Co., the tramp steamer for Messrs. Bull & Co., of New York, and the new United States collier, which will be the largest ship ever built at Baltimore, being about 550 ft. in length, the keel plates for which are being placed.

The new schooner G. J. Cherry was launched from the yard of Frank S. Bowker & Son, at Phippsburg, Me., on Nov. 27. The vessel is 150 ft. long, 33.7 ft. beam, 14 ft. depth of hold, and registers 533 tons gross and 468 tons net. The vessel will hail from Charleston, S. C.



PROFILE OF THE STERN-WHEEL STEAMER ANTELOPE.

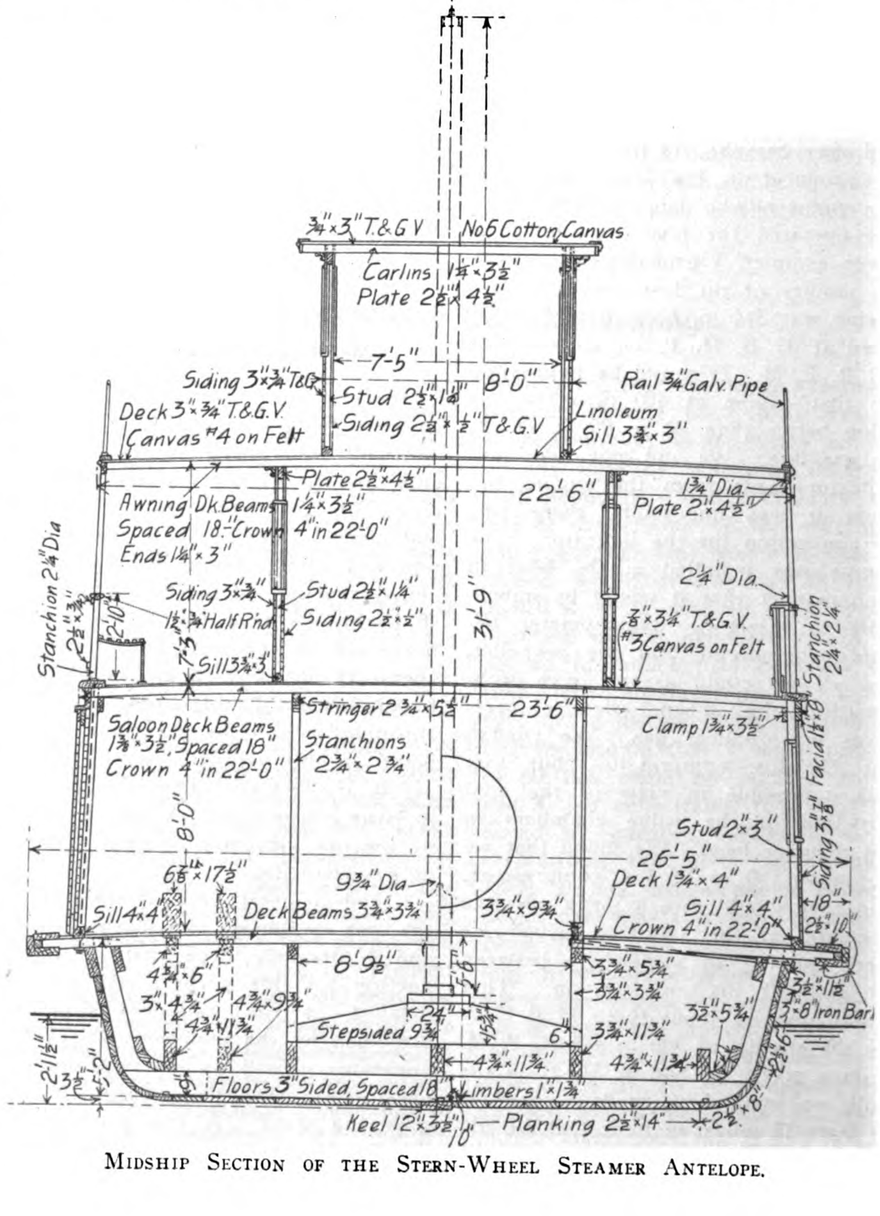
Stern Wheel Ferry Steamer Antelope

ANTELOPE is the name of an old well known stern wheel steamer that has been operating for a good many years on the inland waters of the coast of California. Her history is that of the usual pioneer vessel in a new country. She is now owned by the Hammond Lumber Co. and is doing service on the run from Eureka to Samoa on Humboldt Bay, Humboldt county, California. Recently, however, it was decided to build a new steamer which will be able to more effectually cope with the competition which the old steamer has encountered from motor launches, which have been taking a great part of the passenger traffic without being able to handle teams and other traffic. The new Antelope, also a stern wheel, light draught steamer, was designed by D. W. and R. Z. Dickie, naval architects, San Francisco. The new steamer is being built by her owners, the Hammond Lumber Co., the long-length ship timbers being manufactured by the Bendixen Shipbuilding Co., Eureka, Cal.

The dimensions of the vessel are as follows: Length of hull, 100 ft.; depth, 5 ft. 6 in.; beam, molded, 22 ft. 8 in.; beam overguards, 26 ft. 5 in.; draught, 2 ft. 11½ in.

One feature of the hull is that the entire bow is framed with natural crooks, such lumber being easily obtained at the Hammond Lumber Co.'s mills.

The floors are sided 3 in., except under the boilers, where they are sided 3¾ in. They are spaced 18 in. and molded 10 in. at the keel and 9 in. at the turn of the bilge. The frames are natural crooks sided 3 in., molded 8 in. at the foot and 6 in. at the head. The keel is 3½ x 12 in.; the bottom planking is 2½ x 14 in., at the turn of the bilges 2½ x 8 in. and on the sides 2½ x 6 in. The engine timbers are 6⅞ x 17½ in.



MIDSHIP SECTION OF THE STERN-WHEEL STEAMER ANTELOPE.

There are three decks—a main deck, saloon deck and awning deck. Nothing is carried in the hold except the oil and water tanks forward and alongside of the boiler and the air and circulating pumps aft.

The large water tanks are for the purpose of supplying fresh water to the ships that come into the harbor without the necessity of their coming alongside a wharf.

The horses and teams are to be carried on the lower deck in the freight space between the engine and boiler rooms, differing in this respect from the old boat which carries them on the upper deck. No accommodation is provided for the crew except a room for the watchman on the port side on the main deck. The others sleep ashore.

The women's cabin is handsomely upholstered and finished and is reserved for their use exclusively. The general finish of the joiner work is to be white eggshell gloss and the arrangement is clearly shown on the plans.

The machinery of the older boat, which is practically as good as new, is being thoroughly overhauled and will be installed in the new hull. The engines are tandem compound, of the cross connected stern-wheel engine type with cylinders 14 in. and 28 in. diameter with a common stroke of 36 in. The boiler is new and is of the brick yard type, 16 ft. long, 60 in. diameter, and with 35 R. P. M. a speed of 11 miles per hour is expected.

ITEMS OF GENERAL INTEREST.

The Cunard Steamship Co. has invited tenders for the purchase of the well known trans-Atlantic liner Etruria, which has been laid up at Liverpool for some time.

The Newport News Ship Building & Dry Dock Co. has secured a contract from the Old Dominion Steamship Co. for the building of a new freight and passenger steamer to cost about $500,000. The new steamer will run between New York and Norfolk.

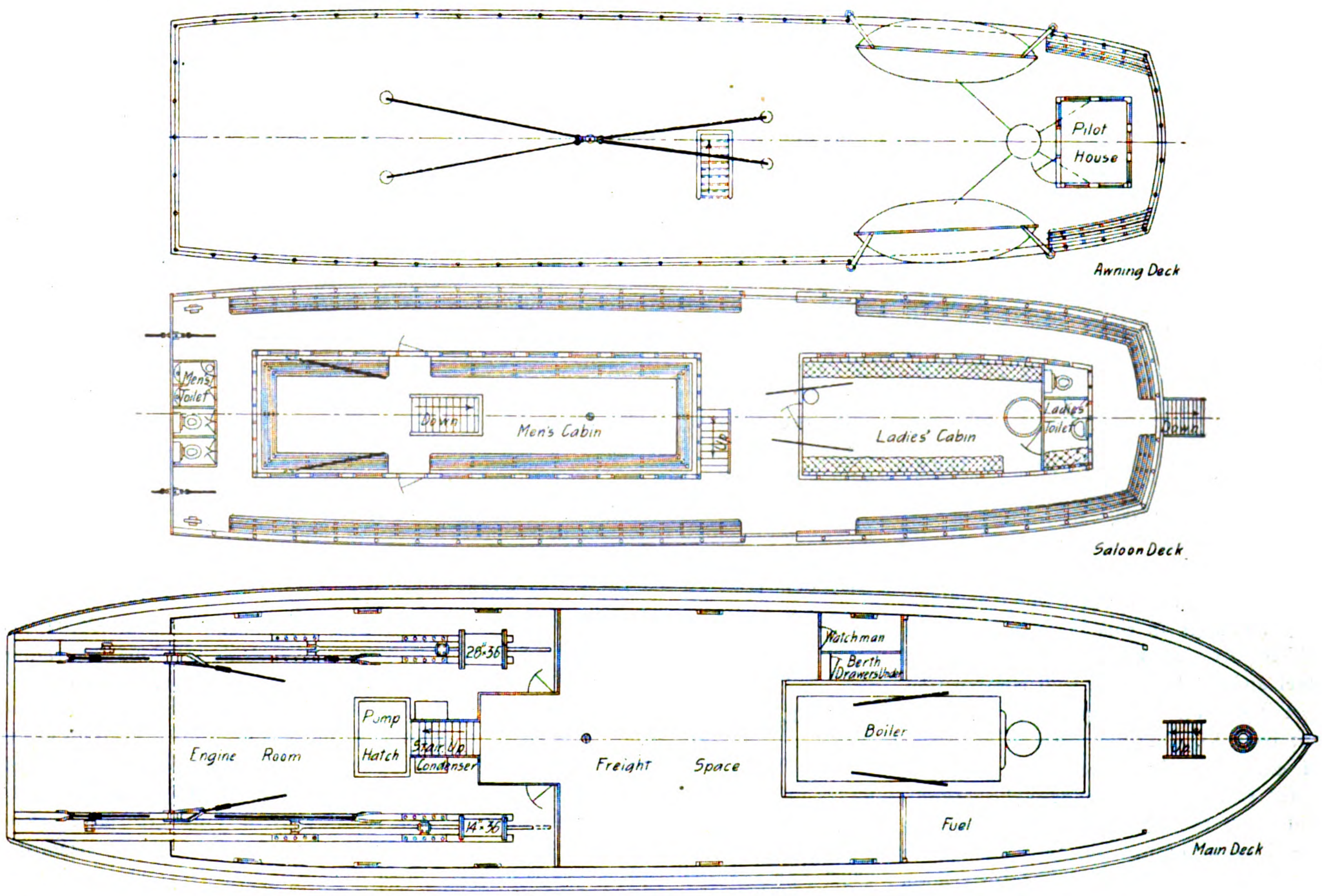
The Pusey & Jones Co., at Wilmington, Del., has been awarded a contract to build a steel tug for the Isthmian canal commission. The contract calls for the delivery of the boat when completed within 10 months at Port Ancon.

A preliminary trial of the new torpedo boat destroyer Lamson, built by the Cramp's Ship Building Co., was made on the Delaware river last month. The vessel made a run as far as Chester and back with satisfactory results.

In exactly 14 days in the Erie Basin ship building plant, the Merchants & Miners steamer Howard was lifted from the water, cut in two, pulled apart and lengthened 40 ft. and placed back in the water and ready for service.

It is reported that the Philadelphia & Gulf Steamship Co. will shortly let contracts for two modern steamers of from 4,000 to 5,000 tons. It is proposed to install limited passenger accommodation on each steamer or else design them in such a manner as to permit of passenger accommodation being fitted when required.

An insurance for over £300,000 has just been offered to the Marine Companies and Lloyds on the hull, etc., of the new steamer recently ordered by the Cunard company from Messrs. Swan, Hunter & Wigham Richardson. The insurance is to be for 18 months and will cover Messrs. Swan & Hunter against the customary builders' risks when the vessel is on the stocks, also during her launch and trial trips, and including the run from the Tyne to Liverpool and until delivery to the owners.



DECK PLANS OF THE STERN-WHEEL STEAMER ANTELOPE.

THE NAVAL WASTE

V*

THERE is one navy yard to I have heretofore made but slight reference—Mare Island, though not for lack of abundant material. Natural conditions are somewhat against this yard, as it is built upon a tide marsh with soft, treacherous bottom. Why the location was ever selected can possibly not be explained now, but real estate deals were probably no rarer 40 years ago than now. The maintenance of a channel is a never-ending fight against the Sacramento river, which deposits silt about as fast as it can be dredged out. Three hundred and fifty thousand dollars was asked for this alone in the last naval appropriation. The money thrown into this channel and spent on roads and foundations in this yard would buy a good location and move every fragment of the existing equipment from the present site. And once more the plea is made for a dredging plant on behalf of this yard and the old lie repeated that it will result in cheaper work.

The saw mill in this yard is housed in an expensive enclosed brick building which cost $75,000, according to the schedule of the Bureau of Yards and Docks, or $6.40 per sq. ft. of floor area. Any number of the best shop and factory buildings in this country, buildings which are working, not loafing, of steel and brick curtain wall construction, cost not over $3.50 per sq. ft., many not over $3. Besides, who in the name of common sense ever saw a Pacific coast saw mill enclosed? The biggest and finest mills on the coast, some with the largest output in the world, are open sided to cheapen construction and facilitate handling stock. These mills cost but a fraction, per unit of floor area, of that of the Mare Island mill. There are two foundries in the yard, but one is closed temporarily. The one now operating employs 30 molders and 20 helpers and has an average weekly output of about 30 tons of iron and brass, or about 200 lb. per day per man. This is almost equal to the product of the two big foundries at the Washington yard which, the chief of ordnance announces with pride together turned out during the year 2,500 tons of castings of every description, a fraction over eight tons per day, or about 80 lb. per day per man, though it is only fair to say the work is of a somewhat different character. These figures will bring a smile to the face of every foundry operator.

*See introductory note in August issue.

Flask Storage Beggars Description.

The flask storage at Mare Island is beyond description; there is no attempt made to care for flasks; they are simply a miscellaneous heap. There are no aisles or "floors" in the foundry, and the utmost disorder predominates. A foundry can never in the nature of things be a very tidy or orderly place, but never was any like Mare Island.

The wasting of money is again exemplified in the building of small boats, which is, however, not peculiar to this yard by any means. Take a small 25-ft. boat, for instance, which will be, and may be expected to be, knocked about and worn out in two years. These boats are copper fastened when galvanized fastenings would answer just as well. A naval officer told me that these boats could be bought for one-half what they cost in the yard "but they would not be so good."

It cost the yard $1,200 to cut out the tubes of torpedo-boat boiler, a job that would be well paid for at $250. For drums for these boilers the material requires four months to obtain to navy specifications, while drums made of material which passes United States steamboat inspection can be bought on the open market for half the money and delivered in as many weeks.

Expensive Power Plant.

The yard is building an expensive power plant, although it can buy all the power it wants for 1½ cents a kilowatt hour, and is buying it at that price now. It will not get a unit out of its own power plant for five times that money. The department seems to have gone mad on the subject of yard power plants, as examination of the reports will show.

The new ship-fitters shop is partially erected after the material *lay on the ground for five years.*

The caisson for the "new dry dock" was built under contract and has been delivered long since, while the dock, authorized in 1898, has only got well started. Compare this with Charleston, previously referred to.

Some figures on what this navy of ours has cost us since we set out to rehabilitate our fleet may not be uninteresting: In 1885 the first ship of the new navy was commissioned. Her displacement was about 3,000 tons. Since that time the displacement tonnage of the United States navy has increased to more than 1,000,000 tons; almost all built or acquired since that year, and not including any of the old wooden sailing ships, hospital or prison ships, receiving ships, tugs, vessels assigned to the naval militias of the various states, nor miscellaneous craft such as launches, barges, lighters, etc., nor submarines.

Cost of the First Ship.

The first ship of the new navy referred to cost about $1,000,000. The latest authorized additions with a displacement of about 24,000 tons each are estimated to cost between $12,000,000 and $15,000,000 each. The cost per ton of displacement has increased from about $350 for an unarmored ship in 1885 to more than $500 in the latest type of battleship, and $1,000 or more in destroyers.

If we average the cost of the fleet at $500 a ton, we have an expenditure of not less than $500,000,000 *for new construction only* and entirely apart from operation maintenance and repairs.

I have not at hand the operation total for those 24 years, but for many years it has averaged $100,000,000 a year, and we cannot go far wrong in averaging the entire period at $75,000,000 a year; we certainly will be rather under than over the mark. This figure, of course, includes the cost of maintenance and additions to shore equipment and makes for the 24 years the tidy sum of $1,800,000,000, or, adding new construction, say *more than $2,250,000,000 for our naval establishment.*

Two Fleets of Battleships.

Now to the foregoing it is proposed by Admiral Evans to add two complete fleets of 24 firstclass battleships each. He says that is what we need. Since the firstclass battleship has advanced in tonnage from that of the oldest on the naval list, the Massachusetts, Indiana, Iowa and Oregon, of 11,000 tons, to the Florida and Utah of about 24,000 tons, in about 15 years, and the oceans of money spent for the purpose have produced less than 30 firstclass battleships in about 20 years, we can, from these figures, readily approximate the cost and tonnage of our 48 ships, even allowing three battleships per year, a rate of construction which is double our

actual average since the first were authorized. It must be borne in mind that the figures as to cost are those indicated by departmental reports and with the exception of such as represent contracts are not of any real value as to accuracy because, as has been repeatedly stated, departmental figures, which in the case of new ships show cost of armament and equipment, carry no charges for interest, depreciation, taxes, insurance or salaries, and the real cost is therefore higher than that assumed. It is also assumed that the definition of "firstclass battleship" will not be held to apply to anything smaller than those now building. Sixteen years then would be required to produce what our experts consider to be our prime necessities. If the rate of increase in tonnage which has obtained in our own and foreign navies during 15 years, should be maintained, the final ship in 1926 would approximate 50,000 tons, and the cost, even though the price per ton showed no increase, would approximate $25,000,000. Now these figures may be ridiculed by naval experts just as they have ridiculed others before only to prove their accuracy later, and it is sincerely to be hoped that they are excessive, but in view of the present ascendency and popularity of the navy, an attempt to carry out this program is not at all unlikely. The average cost of the 48 ships then, would be about $18,000,000, or $864,000,000 for the two fleets which we must have, and this entirely independent of all other construction such as cruisers, torpedo boats, submarines, colliers, etc., and exclusive of the maintenance and operation of the department which already amounts to over $100,000,000 per year. There is nothing whatever sensational or visionary about this estimate, it is only $54,000,000 per year for new battleships. Compare the average of the five years from 1890 to 1895, when our first battleships were built, about $6,000,000, with the $40,000,000 of 1906 and 1907 and judge whether they are overdrawn.

Nor is there the slightest ground for belief that the cost per ton will not go higher, because, while for similar designs the per ton cost should fall with increase in size, yet each succeeding design calls for more intricate and costly equipment and greater elaboration of detail which offsets the gain which would otherwise accrue.

Acquisition of Anthracite Fields.

Let no one think that mere figures will give the naval expert pause. His habit of thought takes no account whatever of where the money is to come from. The ordinary citizen is here to be guided by him and his kind and do his bidding and look pleasant. What do you know about naval ships and fighting anyway? That's what they tell you and without any sugar to it. What they know of the same subject would not take long to tell. Mere millions mean nothing to them. Witness Evans contention:

> I believe that the government of the United States should at once possess itself of the entire anthracite field of Pennsylvania and retain it for purposes of national defense. And if, through accidental discovery, other deposits of this precious mineral are developed, they should be instantly appropriated by the national government and reserved for its own uses. Being a sailor, of course I mean naval uses, first of all.
>
> About eighteen billion dollars would represent, at present values, the available anthracite deposits which the United States government should acquire to possess the entire store of this fuel. The figures are startling; but remember that this vast sum is not necessarily to be disbursed at once. In fact, it may be spent in the course of centuries—only, indeed, as the fuel is mined and consumed. It will be for the actuary to calculate the compensation which the government shall make to the individual owners of the coal fields; to capitalize their holdings, and provide for a systematic reimbursement.

Takes One's Breath Away.

Now if anyone thinks I have handled figures carelessly, let him contemplate that proposition for a few moments. It fairly takes the breath away. All that we have ever spent; all that even the wildest program ever outlined contemplated, sinks into absolute nothingness beside this. People have been restrained of their liberty for advocating schemes a hundred times saner than this crazy idea. Suppose these holdings were capitalized, and bonds issued to cover, even at 3 per cent, the interest alone would be $540,000,000 per year, without providing any sinking fund. Eighteen billion dollars—about three and one-half times the total stock of gold and silver money in the whole world.

But, oh, you Bob! You have such a delicious humor withal. "It will be for the actuary." Certainly. What should a naval officer and one with two titles, official and unofficial, to boot, and the massive brain to conceive such a luminous idea, have to do with base figures? And again: "Being a sailor, I mean naval uses first of all." Again certainly. The heavens and the earth, the sea and all that in them is, were created and exist for the navy. We are not sure the navy were not here first. And "being a sailor" too. Every sailor thinks of the navy first of all, though some of the thoughts would not look well in print. It is to laugh.

Evans needn't wait for the actuary. That's not what he needs. And all this for war—waste. All this to provide employment and justify the existence of a few who tell us we don't know what we are talking about. Listen to his finish:

> Picture the fate of a vast hostile fleet assembled off our Atlantic seaboard, with its colliers and tenders laden with soft coal, belching great clouds of smoke of inky blackness by day and columns of fire by night, while around them circled our swift scouts and cruisers and torpedo boats and, within convenient signal range, our great battleships, each representative of a sovereign state—all well nigh invisible, but ready to dash in at an opportune moment and deal a vital stroke. And all because of anthracite.

Bang! ! ! Well, wouldn't that jar you? "Picture the fate," "pillars of cloud and pillars of fire," "our swift scouts and cruisers and great battleships all well nigh invisible and ready to dash in," and the other fellow doing nothing all the while and doesn't know we're there and just as soon as the admiral has finished his cigar you may fire when you are ready Gridley and we dash in and—come, roll over, you're sleeping on your back. Well, it was a great dream, anyhow!

What Are We Going to Do About It?

But what are we going to do about this question? Are we going to be shaken down by the naval crowd whenever and however they see fit? What good does it do and what does it lead to? Are these letters justified? Let me quote a few letters which have been handed me by the editor of MARINE REVIEW, from people who know whereof they speak. The first two bear signatures of men I know well, prominent ship builders, signatures which are familiar in the navy department attached to contracts for battleships, torpedo boats and other craft, who are at this moment doing business with the department. Says one:

> I have long wondered if it was possible, as I know it has been, for that close corporation, that far-reaching social order, in Washington, called the Army and Navy, the most devilish bureaucracy ever conceived, to continue indefinitely to absorb 70 per cent of the entire revenue of this nation, and the people not find it out. What you have published is all true, though it is not all the truth. You have started the campaign of enlightenment at just the right time. The combination have reached the pinnacle of their success in robbing the treasury. It has made them drunk and careless. They have gone too far and their power is now on the decline. The people see the handwriting on the wall expressed by that one word "bankruptcy"—a condition not impossible for even this great country, a condition which has practically been reached in England and Germany. No merchant marine, no money for lighthouses or for the improvement of internal waterways, nothing left for the conservation of water power, every drop of which will be required by the generations of the near future for heat, power, light and irrigation. The money spent and wasted in this big war game was not produced by us. It was taken from nature's storehouse and squandered by a lot of incompetents, a mortgage put on future posterity with nothing in return. The people seem to be without reasoning power and without thought for the future welfare of our own flesh and blood. Go on and show the people how the war game must stop; the impossibility of any government to expand the taxing power to meet the continuously increasing cost of this great and impossible game of chess. It is child's play and can have only one ending

even under the present program. It will stop, though perhaps not until that great natural law of the survival of the fittest makes itself felt. The richest nation, the one with the greatest power to tax without inciting internal revolution, will survive the longest, and then what of it all? Poverty and suffering for those who are to follow.

And another:

Your articles are mild. They do not state the situation half as bad as it really is. The expenditures for army and navy are at present and prospective too much of a load for even this great and wealthy country to carry and escape bankruptcy. European countries see it, and the single tax budget that the English parliament is now quarreling over is the direct result. It has become a case of more money in continually increasing sums until they have reached a point where the poor have been taxed to the limit and taxes on incomes and the unearned increment is the last resort. We are not far behind them in the United States. To understand the "war system" in Washington one must have been in contact with it and gotten acquainted, and it does not require more than the average intellect to see into it under those conditions. They have in their favor that great power—the flag—which they know so well how to use in arousing the sentimental patriotism of the people to a point where they forget cost and all besides. If I were in a position to be a free lance, nothing would give me greater pleasure than to add my contribution. As it is for the present I must use ordinary business prudence, as others are interested besides myself.

Has anything I have written on the subject approached this for scathing arraignment? And they don't know what they are talking about, say the navy officials. Well, I am reasonably certain that if the names attached to these letters were made public there would be something of a sensation.

A letter from a petty officer on one of our battleships says, amongst other things:

I am in a position to augment your argument relative to the waste in the United States navy, not as a person disgruntled or discontented, but as one who sees and realizes the vast amount of good money ruthlessly wasted daily, yes hourly.

The officer in question turns out, on investigation, to have had, besides his naval experience, a thorough practical and technical training in mechanical engineering, and his observations are, therefore, those of a competent witness.

An officer in charge of one of the navy yards says: "The general conditions governing navy yards are rotten." This officer has perhaps done more efficient work under the handicaps imposed by the system than any other.

Some Newspaper Criticisms.

Now to notice some of the very few criticisms of these letters. The Washington correspondent of the New York *Herald*, quoting naval officials on the appearance of the first of these letters and referring to the charges that the colliers of the fleet were not employed on the great world-girdling cruise, said that it was "a well-known fact that naval colliers accompanied the fleet during the entire cruise."

The facts are exactly as stated and not otherwise, naval officials and the New York *Herald* to the contrary, notwithstanding. The only ship of the collier class that accompanied the fleet was the Ajax, *as a storeship*. The department itself is authority for the statement.

The *Army and Navy Journal* is all fussed up about the charges against the navy. That the *Journal* should take up the cudgels for the defendant department is only to be expected, but to answer it is really a weariness of the flesh. It merely sets up the pins which have been already knocked down. Regarding the comparison of methods in the navy and the merchant marine or commercial establishments, it says:

Any writer on naval matters who compares tramp ships with battleships, and cannot see the necessity of keeping the latter in a higher condition of efficiency, would see no reason why the soldiers of the country should have any more drilling and disciplining than the tramp of the country roads. It surprises us that the *Review* should admit to its columns articles based entirely upon a misconception of the responsibilities of men and things that may be called upon at any moment for the defense of the country. It needs no argument with intelligent fair-minded men to prove that emergency agencies must always be kept at a higher tension and in a greater state of preparedness than those which have only to perform a routine from which it is not intended they shall ever depart. A fire company represents the idea perfectly. Its service is of the emergency kind. At the first signal it must jump and run. Delay of a few seconds may mean its utter failure and make worthless all its months of previous existence. In the very nature of things, its horses and equipment must be kept at the highest state of efficiency. So it is with the fleets of a country. They are to be used in the greatest emergency that can confront the nation. They must be ready for an instant's call, and to compare them to tramp steamers is to display an ignorance of comparative duties that is pitiful.

I have already conceded that such is the expectation and that it is not realized. I will say again that there is not "a rusty old tramp" (since the *Journal* likes that expression) in any port on the coast that cannot get ready and get to sea for any voyage in almost as few hours as the naval ship requires days, and the chances are that she will get there first besides.

Dissertation Merely Froth.

All this dissertation on preparedness is so much froth. It is a delusion and a snare. The statements I have made are not based on misconception nor ignorance, but on actual sea and shipbuilding experience and observation and knowledge of the subject, and upon the department's own reports, which are accessible to anyone, and not upon hearsay nor statements of those on the defense. The *Journal* endeavors to screen the department behind the old excuse of politics. Well, after the moth-eaten, shot-riddled old argument has been made to cover all the possible applications there will be enough left uncovered to warrant condemnation and to spare. I suppose politics keeps naval officials glued to comfortable office chairs while they and their subordinates ought to be up and doing the work for which they are paid and for which the money has been appropriated for years. Politics wants a dry dock at Guantanamo to influence the Cuban vote. Politics wants a navy yard at Pearl harbor so badly that the chief of the bureau of navigation says all other expenditures should be held up for it. How many congressmen come from Hawaii?

Politics demands a fortified naval base in the Philippines so that the little brown brother can vote right. Politics holds up a navy yard at Charleston after spending eight years building because a caisson building in another navy yard is not ready, and then tries to hold a contractor responsible whose contract for an entirely different part of the equipment is only a few months old.

Prodigal Waste.

Politics demands $55,000 locomotive cranes with $75,000 tracks and to be used once in a week in busy times; $20,000 for a little dinky auxiliary hoist worth a few hundreds for an existing crane; $10,000 for a $500 shed for a yard locomotive. Politics builds joke colliers costing a million and a half that the department doesn't know what to do with; demands new boilers for ships less than ten years old that haven't done one year's actual steaming; makes department officials beg information of private concerns, who have spent good money to get it, for the use of classes in naval schools who will later use the hook probably on the very individual who furnished it. Politics builds a ship in a navy yard, where she cannot be docked after she is built and if, as frequently happens, she met with any injury in launching, she must be towed hundreds of miles for repair.

Politics spends millions for power plants, *the interest on which will buy all the power required* from outside sources. Politics forbids that a man shall bend his back and lift anything or that temporary expedients be employed for any purpose, and insists on appropriations for apparatus that is used so seldom that navy yard people *forget what it was bought for.*

Politics probably had nothing to do, however, with the deal whereby naval vessels are not allowed to use anything but eastern coals; a deal that needs investigation, no matter where it leads to. There is a scandal underlying this thing somewhere. Who gets the spoil?

There have been many flimsy excuses advanced on behalf of the navy, but poli-

tics is the thinnest. It was wrong, however, to accuse the department of ulterior motives in hesitating to send the battleship Mississippi up the river to Natchez. It was sheer cowardice born of incapacity. What under heaven will our officers do in the Panama canal, if they couldn't negotiate the lower reach of the Mississippi river?

Cost of the Connecticut.

The *Journal* once more holds up the Connecticut as a sample of navy yard work. I have heretofore paid my respects to the Connecticut and see no reason to modify my views. The less said about the Connecticut the better. We know what the Louisiana cost, less her armament, but no man on earth knows what the Connecticut cost, although we know the figures that are given for it. As to building record, hers was not remarkable; nor even creditable, as every builder knows, whether the editor of the *Journal* does or not. The *Journal's* discussion of this subject is that of the layman. If it were not, the statements regarding "laying off men in slack times," "breaking in thousands of unskilled men," etc., would not find space. It is not the truth, anyway. I say again that no ship building plant in this country, ever, at any time, produced such a beggarly output for the investment and equipment as in the case of the Connecticut. What about the Vestal? And the Prometheus?

Says the *Journal*: "That the longest cruise ever undertaken by a fleet was successfully accomplished should make such diatribes as this impossible." The "longest cruise" will probably displace "the war" as a reference date in the navy, and it is certainly being worked for all it is worth and more. Why in the world shouldn't it be successfully accomplished—in 14 months? What were the ships built for? However, bearing in mind the time the fleet spends in navy yards and at anchor and how averse the officers are to being out on the water after dark, the opinion is not so ill founded after all. I apologize. It *was* wonderful.

Might Have Spared Us That.

The *Journal* winds up with the reiteration of the assurance of good will on the part of the navy for the merchant marine. It might have spared that. If it was the truth these letters might never have been written. It was the attitude of the naval administration towards the merchant marine that prompted them, as already announced.

There is going to be a determined fight made on any and all appropriations for the navy until something is done to rehabilitate our shipping. Without the latter we have no business whatever with the former and still less when its administration is so rotten. "For the defense of the country," needs revision. The country needs defense against the navy and its clamorous crowd of spenders more than any other one thing in the world.

These letters contain numbers of specific statements and charges. They are either true or they are not true. They have been called muck raking, which is neither defense, answer nor argument, but if it is the best the friends of the navy can offer, so much the worse. But there is not a solitary charge which can be refuted. The evidence is there, and mountains besides.

An Investigation Needed.

What the country needs and the navy needs is an investigation. Not an investigation by a board from the department at the bar, nor by senators nor congressmen, but by a board of practical ship builders and manufacturers of kindred lines. There are men of high standing, with no existing affiliations, who have had abundant experience to pass upon every phase of navy yard operation, men who are in touch with naval development and modern progress and who have carried the responsibility for big institutions and for their results who will deal fairly with all questions, and who are a dozen times over better qualified to pass upon the economic needs or methods of our navy yards than any officer or member of the department. Congress can do no bigger, better deed than appoint such a board and see that they get what they want. This tin navy has dominated the country too long. We want a navy and will have one and a good one, but we want its administration clean and efficient.

DOMINION LIGHTHOUSE TENDER NO. 21.

The twin screw steel steamboat, No. 21, which is being built at the Dominion government ship yard, Sorel, Que., was launched there recently and named Montmagny. She will be used in the lighthouse service below Quebec for carrying material and men for lighthouse construction, in distributing supplies for the various stations and for inspection work. Following are her principal dimensions, etc:

Length between perpendiculars....	212 ft. 8 in.
Length over all	222 " 0 "
Beam molded	34 " 8 "
Depth molded to upper deck.....	22 " 0 "
Displacement to l. w. l...........	2064 tons.
Draught of water (loaded)........	15 " 0 "
Cargo at load draught	600 "
Coal at load draught............	230 "
Reserve feed tank at load draught.	25 "
Fresh water tank at load draught..	10 "
Capacity of fore peak tank........	13 "
Capacity of after peak tank.......	45 "
Capacity of double bottom........	120 "
Capacity of trimming tank	85 "
Estimated speed (loaded)	11½ knots.

The vessel is built of steel and is of the flush deck type, with two pole masts. There are three steel decks: the upper one sheathed with wood throughout, the main and lower ones are sheathed with wood only in the way of accommodation. There is a double bottom 3 ft. deep extending through machinery space, and bunker divided into three watertight compartments, that under the boilers forming the reserve feed tank. There are 6 watertight bulkheads. The whole of the steel scantlings are not less than required for Lloyds highest class.

The two lower masts are of steel to the hounds, with pitch pine top masts. The steam winch for the forehold is arranged with suitable derrick and gear for lifting 12 tons with a purchase of two double blocks or 3½ tons direct from the barrel. The after winch will lift 2 tons direct from the barrel. There is a steam and hand windlass for lifting the anchors, also a steam warping capstan aft. The boats include 2 life boats, 3 surf boats, 1 gasoline launch and 1 dinghy.

On the boat deck, which extends the length of the midship deck house, is a wheel house and chart room, with a navigating bridge on top. The steam steering engine is placed in the engine casing, with one wheel on the bridge and one in the wheel house, there is also screw hand gear aft. The vessel is lighted throughout with electric light including signal lanterns and is fitted with wireless telegraph apparatus.

The machinery consists of twin screw triple-expansion engines, having cylinders 15 in., 24 in., and 39 in. diameter by 24 in. stroke, supplied with steam from 2 boilers of the marine return tube type, 14 ft. diameter by 10 ft. long each, having three furnaces 3 ft. 3 in. diameter and 272 3 in. tubes. The working pressure is 180 lbs. per square inch. There is a donkey boiler of the vertical type, 5 ft. diameter by 9 ft. 2 in. high; working pressure, 125 lbs. The auxiliaries include a feed pump, ballast pump, general service and fire pump, feed heater, sanitary and fresh water pumps, also ash injector. A "navy" type hand pump is placed in the casing and connected to the general service pump for use when steam is not available.

RECORD ORE LOADING FOR A SINGLE SPOUT.

The Iron Trade Review of Oct. 14 contained a description of the iron ore properties of the Nova Scotia Steel & Coal Co. at Wabana, Newfoundland. In the description the statement was made that ore was loaded aboard vessels at the company's dock through a single spout at the rate of 2,000 tons per hour. This was really so surprising a performance that *The Iron Trade Review* hesitated to publish the statement without further corroboration. The system of loading ore upon vessels has reached a high state of perfection on the great lakes. Over 10,000 tons of ore were put aboard the steamer Corey at Two Harbors in 39 minutes recently, but this was through 33 spouts. The statement, therefore, that the Nova Scotia Steel & Coal Co. loaded 2,000 tons per hour through a single spout seemed incredible until an explanation of the performance was received from Thomas Cantley, general manager of the company. His explanation of the machinery and physical condition that permits this is quite interesting. He writes:

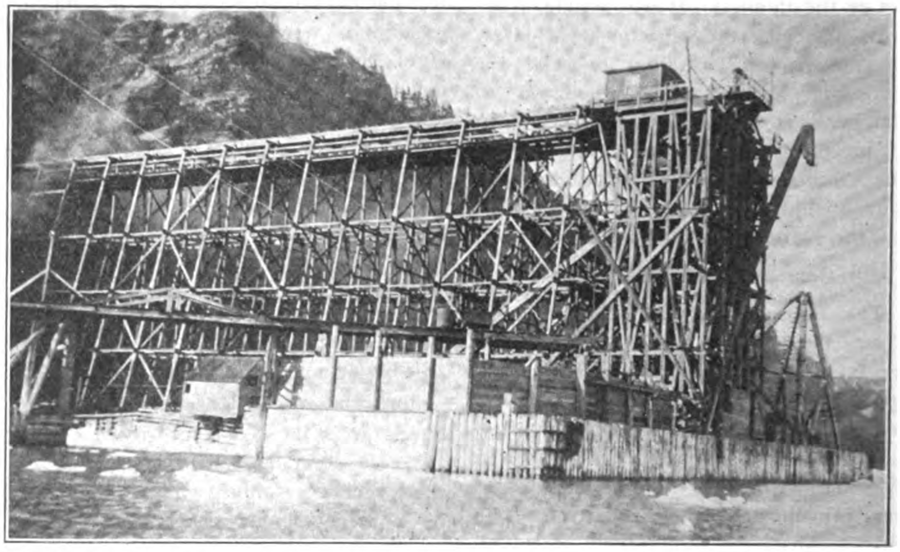


Fig. 2—Ore Loading Pier. The Conveyor Runs Along the Top.

As shown by the illustrations and description, the loading-pier at Wabana has only one chute or spout, notwithstanding this, the rate of shipment of 2,000 tons per hour has on many instances been exceeded. We think that we are more or less conversant with what can be done by all the principal ore-loading piers both on this continent and abroad, and have long been aware that we were probably putting more material over a single spout than was possible in any other installation in the world. The secret of our success in this direction is not far to seek.

First, we have a shore-pocket in the upper part of a "V"-shaped gulch. This pocket has a capacity of between 25,000 and 30,000 tons. A tunnel is driven underneath this pocket, in which is installed a large and very powerful bucket-conveyor, the buckets being formed out of steel sheets approximate "V"-shaped in section with a capacity of over one ton each, the supporting links being about 42-inch centers. This conveyor, after passing out of the tunnel, is carried on a trestle to the top of the pier, and drops its load directly into a small bin holding from 500 to 700 tons. The spout is attached to the outer face of this bin in such a manner as to give it considerable flexibility, that is, its outer end is capable of moving about 30 degrees on either side of the right-angle line of the dock. On its outer end is attached what we call a trimmer, which device enables us to shoot the ore to either wing of the ship's hold. The conveyor itself will easily convey from the shore-pocket to the small pier pocket at considerably over 3,000 tons of ore per hour, and has done so daily for months. We have repeatedly loaded boats at the rate of over 40 tons per minute. By this we mean that the lapsed time from the moment of beginning to load until all the cargo was aboard, and includes the time lost in shifting the ship so as to bring the spout to bear on four different hatches. In other words, a steamer of 8,000 tons has been loaded in three hours and twenty minutes. This record has been equalled in numbers of cases in vessels of other dimensions.

The method of loading at Lake Superior docks by a large number of hatches is, of course, quite different, and in some cases is a very much simpler one.

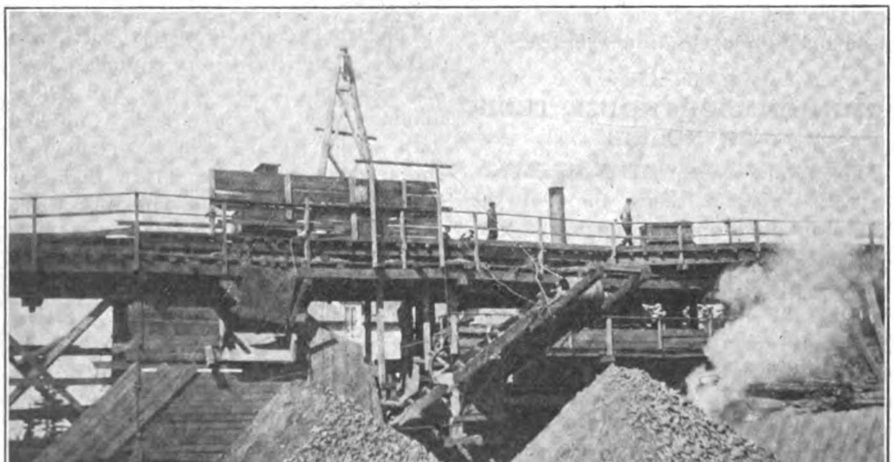
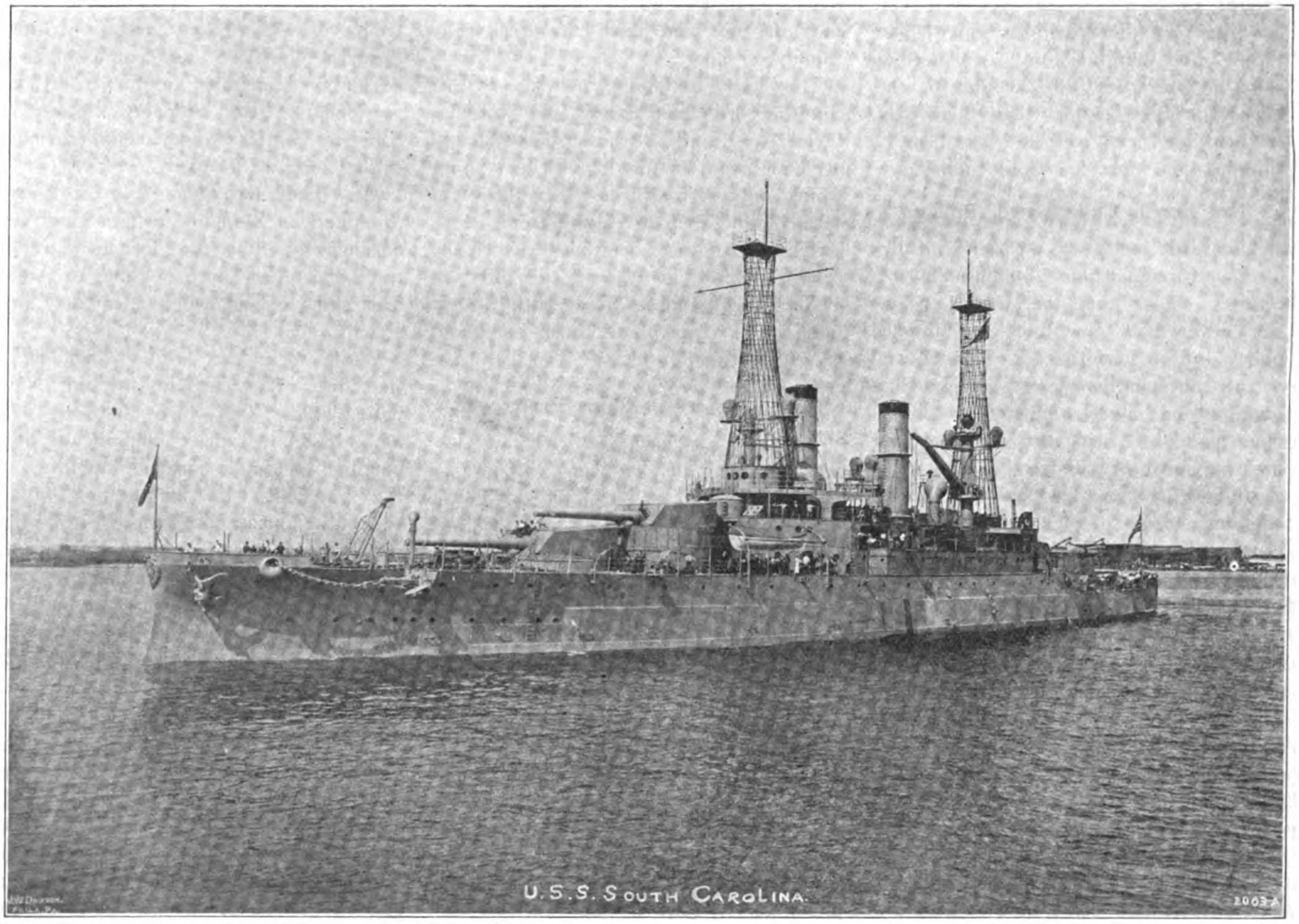


Fig. 1—Belt Conveyor Discharging Mineral Into Pocket at Loading Pier.

BRITAIN'S GIANT CRUISER RECORD TURBINE POWER.

The cruiser, or, to be more correct, the battleship cruiser, which is to be started on at Devonport Dockyard next month, is evidently to be a record maker in size, power and speed. It has been stated that the order for the turbine machinery has been placed with Messrs. Vickers Sons and Maxim of Barrow, who were the constructors of the Dreadnought's turbines, and although there is no official confirmation of the rumor it can be taken to be correct. These turbines are to be no less than 70,000 I. H. P.; a record power for the world. The horsepower of the Mauretania is 66,000, giving a shade above 25 knots. This new cruiser will be some 200 ft. shorter, a few feet narrower, and yet will have 4,000 more horsepower. The present St. Vincent class of Dreadnoughts now completing have about 25,000 I. H. P., while the Invincible class, which have reeled off 27 knots have 45,000 I. H. P.



BATTLESHIP SOUTH CAROLINA, BUILT BY WILLIAM CRAMP & SONS SHIP & ENGINE BUILDING CO., PHILADELPHIA, PA.

The Foreign Trade Merchant Marine of the United States--Can It be Revived?*

BY G. W. DICKIE, ESQ., MEMBER OF COUNCIL.

ABOUT one year ago when the society was considering where to hold a spring meeting I suggested that it should come to the Pacific coast and hold its meeting on the shore of the great ocean on whose waters has begun a battle for the carrying trade between the oldest and the newest civilizations. The final result of that struggle and the part we may be able to take in it are of vital importance to the members of this society; this is my excuse for bringing before you a subject somewhat out of the regular course of technical matters discussed at our meetings.

Out on the western edge of this great country we are too sick to take any interest in the technical details of our profession; we are in a battle for life with the chances all against us. Naval architecture in the abstract has no charms when there are no ships building for which to be the architects.

In presenting this subject to the society I would like to be able to say something that I have not said during the past 25 years in which I have been talking about it. The conditions have changed materially during these years; nations have come to the front outstripping us in the race for the ocean-carrying trade; these nations we did not formerly consider as possible rivals. This condition is especially apparent in the carrying trade of the Pacific.

The Ambition of Japan.

Thirteen years ago I was walking the deck of a British warship in the harbor of Yokohama with a Japanese cabinet minister, the captain of the ship and a fleet engineer; we were talking of naval strength and merchant marine when the Japanese minister remarked that the ambition of Japan was to be to the Pacific ocean what Great Britain was to the Atlantic. We had been boasting of the naval powers of the countries we represented and did not consider that there was anything more in the remark made by the Japanese than there was in those made by ourselves. As I write this a stately Japanese liner sweeps down San Francisco bay and I am forced to admire her as she passes in full view of my office window, carrying the United States mails and two millions of dollars in gold bars in her specie room to help pay up the balance of trade.

The Japanese have recently built some trans-Pacific liners much more advanced in design than any naval architect in this country has had a

*Paper read before the Society of Naval Architects and Marine Engineers. New York, Nov. 18, 1909.

chance to produce, and yet we were building trans-Pacific liners long before they were building any ocean-going ships. How are we to account for this but by acknowledging that their government has been wise in regard to its shipping and ours has been foolish.

No Fixed Enlightened Policy.

A careful study of the early history of the foreign trade shipping of this country shows that the United States has never had any fixed, enlightened policy of fostering any growth and permanent stability of her foreign shipping but has always adopted a temporizing policy to meet the evil that was pressing most heavily at the time. Such a study will also show that the foreign shipping trade of this country never prospered, even in the days of wooden ships, without substantial protection, and this is due to the fact that every nation which aspires to maritime power has been willing to pay for it.

As early as 1784 the effect of the foreign policy of Britain, which aimed to prevent the loss of the colonial shipping with the loss of the colonies themselves, began to be felt in the new republic and excited universal attention and disquietude; this was so to such an extent that Congress made an application to the several states for a grant of power for a limited time to regulate foreign commerce; but even at that time, as now, the states did not at all think alike about it and the effort failed. The several states next endeavored to effect their purpose by independent regulations, as they had done in colonial times, but a new order of things had come and this method would not work. This is not without its value, however, for out of this experience grew the measures which resulted in the establishment of a government apparently competent to regulate the commercial interests and vindicate the commercial rights of the republic.

Need of Shipping Encouragement.

It is interesting to note that the needs for shipping encouragement requiring united action was what finally led to the establishment of the Federal government, and the measures then adopted (1789) when the regulation of commerce was vested in the general government, consisting of discriminating duties in favor of American ships, and tonnage dues charged on foreign ships comprised the "Navigation Laws" of the United States, as enacted by the first congress. From 1789 to the war of 1812 a wonderful recovery of fortune resulted from the discrimination against goods carried in foreign vessels, industries took root in the land and enterprise fully employed labor.

The early shipping policy of this country originated with the colonies themselves and differed somewhat in principle from that of the British under which only British vessels could carry cargo into British ports from Asia, Africa or America, or trade between the colonies, while in Europe the different nations might trade direct with Britain from their own ports on payment of discriminating duties.

Giving American Ships Preference.

The American system was permissive, giving their own ships a preference in their own trade through their tonnage and tariff duties which were discriminating. The British shipping law had eight distinct prohibitions, while the American had none prior to 1817, when two acts of congress were passed, one confining foreign vessels to direct trade, the other excluding them from domestic traffic. There is no doubt that these laws had a wonderful effect in stimulating American shipping, notwithstanding the hard fight that Great Britain made against them. In 1789, when protection began, the foreign trade shipping of the United States amounted to only 123,893 tons, including both exports and imports carried in American bottoms and forming but 17½ per cent of the imports and 30 per cent of the exports. In ten years the shipping of the United States engaged in foreign trade had increased to 657,142 tons, forming 90 per cent of the imports and 87 per cent of the exports. During the war of 1812 the percentage of the foreign trade carried by American ships fell to 71 per cent of the imports and 51 per cent of the exports. Under the original navigation laws in 1825 the United States carried in her own ships 95.2 per cent of her imports and 89.6 per cent of her exports, and this is the highest point reached by American shipping in the foreign trade.

Effective Navigation Laws.

The navigation laws were so effective at the beginning of the history of the United States that a good many of the friends of American shipping think that the restoration of these laws would again give to the United States her fair share in the foreign transportation of the country. A bill was introduced before congress on March 10, 1908, for this purpose. It was entitled "A Bill to Equalize the Footing of Ships in Foreign Trade by Constitutional Regulations." This bill emanated from W. W. Bates, naval architect, formerly United States commissioner of navigation, a member of this society, and president of the Shipping Society of America, whose headquarters, curiously enough, are in Denver.

Mr. Bates has done a great service to American shipping by showing very conclusively that the foreign carrying trade has never been possible to American ships except when adequately protected.

While there can be no doubt as to the effect of a return to the old "Navigation Laws," in force between 1789 and 1828, on the shipping of this country, there is grave doubt as to the possibility of maintaining, under such laws, pleasant relations with other nations who are doing business on the oceans; when these laws were enacted they were retaliatory measures effective under the conditions then existent against similar measures in use by other nations.

Not Possible to Apply Now.

While the protection afforded by tonnage duties levied on foreign vessels, and discriminating duties on cargoes entering in foreign vessels, might, if they had continued, have kept the foreign trade largely in the hands of our own ship owners, yet these old measures, effective though they were, could not again be effectively applied. The world has changed since 1828 and nations bear different relations to each other than they did 100 years ago. At that time when a nation wanted anything it usually set about devising some way whereby some other nation was forced to pay the cost of getting it. Now, when a nation wants anything that is necessary to its prosperity, it finds out what it will cost and, if it can afford it, pays the bill. That is what we will have to do if we want a merchant marine in the foreign trade.

It is not necessary to waste any time describing existing conditions as far as the merchant marine in the foreign trade is concerned, for it is a matter of universal knowledge and I think of universal regret that our foreign shipping trade is driven from the ocean. At the present time about 93 per cent of our foreign commerce is being carried in foreign ships under foreign flags.

Wise National Laws Needed.

To enable us to participate in ocean commerce to the extent that our imports and exports entitle us to there must

be: First, ambition enough throughout the country to carry the products of our industry in our own ships to any country which cares to exchange products with us, and that ambition must be strong enough to enable us to face the apparent cost; and second, there must be wise national laws to protect and foster our merchant marine, making it possible for our ship builders to build and equip ships and for our ship owners to purchase and operate them; third, there must be state and municipal laws on the part of sea-girt states and maritime cities encouraging ship owning and ship building within their own borders.

This country is so constituted that nothing can be done to foster American shipping unless the people demand that the government do what is necessary to recover her lost place on the ocean.

Naturally Turned to the Sea.

It is evident that a country like this, having an immense seaboard on the two great oceans of the world, great power, both naval and commercial, is a very desirable thing, yet the history of this country shows that at certain stages in the development of such a country it is not a prime necessity. In its early history, when its people found it absolutely necessary to protect its shipping, with the population centered on the Atlantic seaboard and depending on an interchange of commodities between the mother country and her colonies, the energies and accumulated wealth of the people naturally turned to the sea. Behind them was a great forest of magnificent timber for building ships and in front of them a great ocean highway leading to all the countries of the earth. With such opportunities this young and vigorous country, in the beginning of the last century, found an extensive merchant shipping an absolute necessity to its development and growth in wealth and power. Her first legislative acts were promulgated for the purpose of protecting the growing sea power of the young republic; these imposed extra duties on foreign ships, thus preventing them from getting any hold on the export and import trade of the United States as long as such measures were in force.

Destruction During Civil War.

The destruction of a part of our shipping during the civil war used to be given as a reason for the rapid decline of our foreign shipping trade; this is an error that it is natural to fall into. The truth is that a steady decline began from the time, 1828, that the foreign carrying trade of the country was opened free to foreign ships, at which time the final restrictions on competition by all countries in our foreign trade were removed. From 1825, when this country carried in her own ships 95.2 per cent of her imports and 89.6 per cent of her exports, to 1840 the percentage had fallen to 86.6 per cent of her imports and 80 per cent of her exports; in 1850 she carried 78 per cent imports and 66 per cent exports; in 1860, 63 per cent imports and 69 per cent exports, and this decline was before the war, during which there were neither imports from nor exports to the southern states; since then the same trend of our trade shows in the statistics of our commerce as shown by the following returns:—

In 1870, 33 per cent imports, and 38 per cent exports.

In 1880, 22 per cent imports, and 14 per cent exports.

In 1890, 17 per cent imports, and 9 per cent exports.

In 1900, 12 per cent imports, and 7 per cent exports.

Since 1900 the decline has continued.

That the shipping interests of the United States did not recover from the injuries received during the civil war, but kept on steadily declining as they had done before the war, is in itself an indication that a merchant marine was not absolutely necessary to the development of this country; had it been a necessity the people would have demanded laws fostering the shipping interests.

First Bill Passed in 1828.

It is interesting to note that the same nonsense about the great superiority of American skill that so largely prevails today prevailed with even more force in 1828. The first bill to abandon American shipping to its own resources was passed in 1828. Its passage was managed by Senator Woodbury, of New Hampshire; in his speech he says: "We are known to possess a skill and economy in building vessels, a cheapness in fitting them out, an activity in sailing them, which, without discrimination, would give us an advantage in coping with any commercial power in existence. Such are the accurate calculations of our merchants, the youth and agility of our seamen, and the intelligence of our shipmasters, that American vessels can, on an average, make three trips to Europe while a foreign vessel is making two. It must be manifest to all that circumstances such as these rather than any discriminating duties, must always give and maintain to us a superiority and protection which leaves nothing to be feared from the fullest competition."

In spite of this wonderful superiority the removal of a protective duty of less than one-fourth the then prevailing freight rate drove the American ship out of that trade; if the ships were cheaper and could make three voyages to the other's two, how could this have happened?

Passed by a Protection Congress.

The act of 1828 was not passed by a free trade congress but by the very same men who enacted the extraordinary tariff bill of 1828. In this instance the same men were eloquent on the helpless condition of American industries in facing the fierce competition of the European factories with their generations of experience and labor with more efficiency and less pay than the same class of operatives gave and received in America. Such is the strange inconsistency of the lawmaker, ancient and modern.

Besides the loss of all protection to American shipping in the foreign trade other forces began to operate and finally became powerful factors in hastening the decline of American shipping.

One of these was the change which began to take place in method of constructing ships. The native oak of Old England, that had enabled her flag "to brave a thousand years the battle and the breeze," was becoming a very scarce article, and ships being an absolute necessity to her power and position among the nations, a new material had to be found out of which to build ships. This new material, first iron, then steel, had been gradually gaining the confidence of "those who go down to the sea in ships and do business on the great waters," and while the Confederate States' cruisers were burning the best wooden ships that carried the stars and stripes, the British ship yards were learning the most economical methods whereby iron and steel plates and bars could be given the form of ships to carry freight and not only equal the wooden walls in strength and power to carry but to exceed the best that the ship builders' art could do in wood. This new material gave Great Britain her opportunity not only to maintain her position on the sea but to extend it to a magnificence that became the wonder of the latter half of the nineteenth century. The American ship owners and ship builders saw all this going on and doubtless understood how it would end, but in their country ship building and ship

owning was not a national necessity in the same sense as it was in Britain, and the people, most of whom had never smelt salt water, were, and still are, indifferent. The necessity for American ships in the foreign trade of this country has been considered as only a personal matter of the ship builders and ship owners, and not a vital national question; in Great Britain, on the contrary, her position among the nations is held to depend on her naval supremacy, and so the British ship builder had only to learn well his business of building good ships and his government saw to it that the ship owners should not lack encouragement to use them. The ship builders of this country have been unable to get their country to make any real effort to get and to hold the oversea carrying trade that belongs to it. The ship builder has mastered the science of modern ship building and has brought into existence the plants necessary for building the highest class of ocean carriers, but no response in the shape of protection for the products of these yards has come from the people.

Must Have Our Own Ships.

Thoughtful men here and there, and especially in states facing the oceans, are beginning to feel that the time has come when this country must begin the work of building up an ocean commerce through ships bearing our own flag.

When this country once realizes that the time has come when it is a national necessity that merchant ships built in our own ship yards, officered, and, if possible, manned by our own citizens, owned and operated by our progressive men of affairs, shall represent our enterprise and power in all parts of the world, there will be found a way to do it with profit to all concerned. Efforts to stimulate shipping will then be understood by the people and questions regarding such matters and needing legislation will be treated in the manner that their importance demands. Admitting to register foreign-built ships, as now proposed in a measure before congress, will not revive the shipping of this country; if it would the ship builder might be willing to be sacrificed in order that such a result might follow. A country that could not build ships has never, as far as I have been able to find, been able to own and operate them.

Transfer of Finland and Kroonland.

The absurdity of such a proposition was very forcibly illustrated by the president of the society in his opening address at the meeting held last November in his reference to the transfer of the two largest American-built ships in the trans-Atlantic trade, the Finland and the Kroonland, from American to Belgian registry for the purpose of securing the advantages of lower wages and cheaper maintenance under foreign colors. Might we not dispense with protection for every industry in order to secure the advantage of lower wages and cheaper living as found in foreign countries? The necessity of doing our own foreign carrying trade is growing upon us faster than some of us care to admit. Under present conditions the value of our exports is, in round figures, $1,750,000,000, and of our imports, $1,250,000,000, leaving a balance of about $500,000,000 which appears to be diminishing very rapidly and it is this balance which insures our continued prosperity. With this great export and import trade carried in our own ships one-half this balance would produce the same result. It may be doubted whether this country will be able to continue to furnish exports sufficient to maintain this balance in our favor and continue to pay about $250,000,000 annually to foreign shipowners to carry it for us.

Our Great Export Trade.

We are in the habit of pointing with pride to our export trade of one and three-quarters billions of dollars and often claim that it is the result of our skill as producers and of our foresight as international merchants. Will you pardon me if I suggest that this great export trade cannot be attributed to either our skill as manufacturers or our foresight as merchants. Of our aggregate exports over one billion consists of raw cotton, food products, petroleum products, lumber and other raw materials of which we produce a surplus and of which the rest of the world must have a supply.

There is a time coming when the rapidly increasing population of this country will be more urban than it is now, when factories will multiply more rapidly than farms, when the United States will need new and important markets; the world may come to us in its own ships for the products of our farms and for the raw materials from our mines, but it will not come in its own ships for the finished products of our factories. When that time comes, and it is near at hand, we will need international merchants, international bankers, and an international merchant marine.

There are reasons why the American ship cannot compete with the foreign ship in the ocean carrying trade. National conditions over which our ship-builders or ship owners have no control and which they are powerless to change make the cost of building vessels in the United States from 30 to 40 per cent greater than in other countries. The cost of manning and victualing these American ships is also much greater, probably not less than 30 per cent more than manning and victualing foreign ships. In addition there are other expenses in the operation of vessels which are greater in the United States than they are in other countries, such as taxes, repairs, outfit, and equipment. Most of these higher costs are the outgrowth of conditions resulting from the policy of high protection to industries that have been developed under laws first enacted, strange as it may seem, by the very Congress that removed all protection from shipping engaged in the foreign trade and which policy has continued through all the period that American shipping engaged in the foreign trade has been declining.

The cost of the materials entering into the construction and outfit of American vessels is necessarily higher because of the conditions that obtain in other industries that are highly prosperous under the conditions that obtain under the protection afforded by the tariff—industries producing precisely the same materials that are employed in building and outfitting ships. The wages of the workmen employed in our shipyards are on the same high scale due to the general standard of wages prevailing in similar industries that are great, powerful, and profitable under tariff protection.

American and British Workmen.

It is sometimes claimed that the American workman is superior to his British brother and will produce as much for the wages paid as any workman in the world. There does not appear to be any foundation for this claim as applied to the workmen in American shipyards, as a large proportion of them come from the yards in Great Britain. For piece work, of which a good deal is done in shipyards, the price bears about the same ratio to the wages paid here as their piece work price bears to the wages paid there, and the wages average 50 per cent higher here than there. While these conditions continue to exist it is futile to suggest, as has sometimes been done by those who know better, that ships can be built as cheaply

here as abroad. If ships could be built as cheap here as there they would be so bulit, and the fact that they are not built at all indicates that the'r cost renders them unprofitable in competition with foreign vessels.

If other nations did none of the things that they so long have done and continue to do for the encouragement and maintenance of their merchant shipping, the difference in cost of construction, operation, etc., between American and foreign built vessels would alone suffice to make it unprofitable and hence unattractive to Americans to invest in or build ships in the United States for the foreign trade; but when we add to these undeniable advantages that the foreign competitors possess over our own citizens the advantage they also possess through government assistance and regulation, then the reason why the American vessel in the foreign trade is a thing of the past is easily understood.

What Other Nations Are Doing.

It is not necessary to go into what other nations are doing for the stimulation of their foreign trade:

The United States pays for the carriage of her mails about $1,600,000 per annum.

Great Britain pays, including admiralty subvention, about $7,000,000 per annum.

France pays, including bounties on construction and navigation, about $9,500,000 per annum.

Germany pays for mail service about $3,000,000 per annum.

Russia pays to ships under her postal regulations about $2,000,000 per annum.

Japan pays in subventions about $6,200,000 per annum.

Italy pays in subventions about $2,700,000 per annum.

Australian Line Withdrawn.

Immediately after the defeat of the shipping bill of 1907, on March 9, five days after the adjournment of Congress, the Oceanic Steamship Co., of San Francisco, notified the Post Office Department that it would have to withdraw its line to Australia. This line had been operating under the ocean mail law of 1891 and after five years of trial had found the rate of compensation for 16-knot steamers utterly inadequate on the long and costly route of 8,329 knots from the Golden Gate via Hawaii across the South Pacific to Samoa, New Zealand and Australia. The requirements of the mail contract were such that the Oceanic steamers were forced to attempt to make a speed beyond their capacity over such a vast distance and for this hard service this American company, employing well paid American officers and crews, was given a compensation by the United States of only $16,639 per voyage at 16 knots as compared with $41,604 per voyage given by Germany to the Australian liners of the North German-Lloyd at 15 knots; $47,814 per voyage given by France to the French-Australian liners at 15 knots; $21,917 per voyage given by Japan to her Yokohama-Australian line at 14 knots, and $23,077 per voyage given by Great Britain to the Orient line to Australia at 15 knots; this latter has just been increased to $36,250 per voyage for a 16-knot service for which new ships have just been built. All these lines are operated at a cost of at least 30 per cent less than the American ships and, with the exception of the new contract with the Orient line, are allowed to proceed at a lower speed. Under these circumstances, then, the Oceanic Steamship Co.'s ships were taken off their run, their officers and crews discharged, the ships dismantled and laid up in San Francisco Bay, where they still are.

Our Roundabout Mail Deliveries.

Thus the American flag has vanished from the commercial routes of the South Pacific, our only communication with the naval station and garrison of Samoa cut off, and three good passenger, mail, and freight boats are eliminated from the trade between Hawaii and the main land of the United States, forcing the people of that prosperous island to ask Congress to permit foreign passenger vessels to fill the blank.

Our business men when they wish to communicate with Australia or New Zealand by mail, must now send their letters by a roundabout way in some British or Canadian steamer subsidized under an agreement that its owner shall do all he can to favor the trade of Great Britain and Canada. Under these conditions what is to become of the export trade that we have built up with Australia which has grown in a few years from $12,000,000 per year to $29,000,000 per year, largely through the service given by the Oceanic Steamship Co.? This company disbursed over $1,000,000 annually on the water front of San Francisco, and over 2,500 passengers per year carried by these ships passed through San Francisco, leaving not only impressions upon us, but money with us. San Francisco exports to Australia have fallen off over $1,000,000 per annum with the stoppage of this line and that means something to our producers.

Now in the face of all this disaster to our foreign trade shipping what is government doing to turn this tide that sets so heavily against us? Nothing except to persevere in policies that hasten the final downfall of the little that is left of a once flourishing industry.

Seldom Saw American Flag.

Our people will pay without a murmur for a big navy and they will send it all around the world to show that there is an American flag; it must have been saluted very seldom by American ships in the foreign harbors it visited. It is presumed that the navy is built to fight and I know it would do so with honor if called upon to do so, but no one seems to expect that it will ever be called upon to "make good." So we are quite content to send our navy around the world in a spectacular manner to show our flag, which is a strange sight in this generation to most countries, and we are willing to pay over $100,000,000 per year for the development and upkeep of this splendid navy. Other nations have noted that this costly and very fine war fleet of ours cannot go out of sight of our own shores without requiring the attendance of a fleet of foreign merchant vessels to keep it supplied with fuel and other necessities. If it should be unfortunately called upon at the present time to do that for which it was built, to fight upon the high seas at some distance from its own depots, who would supply it with the sinews of war when, in the day of need, the foreigner could not come to our aid? That is not a question that people care to answer.

The Japanese Policy.

Japan answers the above question on behalf of her own policy through the Japan *Daily Mail* from which I quote:

"The Japanese government has to choose one of two things: either it must have a special service of government transports or it must bring into existence a merchant marine such as will furnish transports at any moment. England has subsidized steamship companies whose vessels always hold themselves in readiness to act as transports. Besides, there is the enormous number of vessels plying to and from all parts of the world under

the British flag and upon these she can draw in time of need, and Japan must in proportion to her war fleet have her merchant ships ready in case of need. Without the aid which her merchant marine was able to furnish in 1904 her war with Russia could never have been conducted to a successful issue."

The problem of the Japanese mercantile marine is, therefore, not such a simple thing as it looks and its future may be of much interest to us.

Future of Japan's Marine.

It may be said that the Japanese government will not be able to continue the payment of such large bounties to the steamship lines that are developing her trade on the Pacific; but I think we will find, possibly when it is too late, that Japan can better afford to pay what is necessary to secure that trade than to do without it; the sentiment in Japan appears to be the reverse of what it is here. I will quote again from the Japan *Daily Mail*:

"The present expenditure on the navy is part of the nation's policy calling forth vehement criticism among the mercantile community at home and the nation's critics both at home and abroad. The encouragement given to shipping and shipbuilding is generally acquiesced in as essential to development. The number of years required before these can be self-supporting and independent of subsidy can scarcely be estimated; the future alone can decide."

I do not believe that we should follow the French method; ships can be put on the ocean and navigated from one port to another if their expenses are paid, but this nursing is without any sound economic policy to back it up; I believe it gives no ultimate benefit to the commerce of the nation adopting it.

Permanent Lines of Communication.

In my belief the first duty of the United States is to establish permanent lines of communication between her ports and the principal ports of the world, especially those where our products would be most likely to find a permanent market. The character of the service should be clearly stated and bids for the service required should be asked from responsible ship owners and awards made to the lowest responsible bidder. In this connection I would suggest the following as probably meeting the present requirements of our commerce with outside nations.

I suggest that Congress authorize mail subventions in the necessary amounts to establish the following steamship lines, the steamships for which shall be built in the United States and be wholly owned by citizens of the United States; these ships to be of the most modern type, designed for the service in which they are to be operated; the service to be for 15 years; the subvention to be awarded to the lowest bidder who shall give satisfactory guarantee that within two years from the date of contract he will have the line in operation. All officers and at least 10 per cent of the crew of such vessels to be American citizens. The speed named in the contract to be the average sea speed on the voyage, and the average speed of six months' operation to be taken as the speed under the terms of the contract. United States mails to be carried free of charge, and the passenger accommodations to be first-class and ample for the probable needs of the service.

The Schedule Proposed.

1. From an Atlantic port to Brazil; monthly; speed 14 knots; 5,000 tons gross or over.
2. From an Atlantic port to Uruguay and Argentina, monthly; speed 14 knots; 5,000 tons gross or over.
3. From an Atlantic port to South Africa; monthly; speed 12 knots; 6,000 tons gross or over.
4. From a Puget Sound port and San Francisco to South Africa; monthly; speed 12 knots; 6,000 tons gross or over.
5. From a Gulf port to Brazil; monthly; speed 12 knots; 3,000 tons gross or over.
6. Atlantic and Gulf ports to Cuba; monthly; speed 12 knots; 3,000 tons gross or over.
7. New Orleans to Mexico and Central America; weekly; speed 14 knots; 3,000 tons gross or over.
8. Gulf ports to Mexico; weekly; speed 12 knots; 2,500 tons gross or over.
9. San Francisco to Japan, China and the Philippine Islands; fortnightly; speed 17 knots; 12,000 tons gross or over.
10. Puget Sound to Japan, China and the Philippine Islands; monthly; speed 14 knots; 10,000 tons gross or over.
11. Puget Sound and San Francisco to Samoa and Australia, including Honolulu; fortnightly; speed 16 knots; 8,000 tons gross or over.
12. Puget Sound and San Francisco to Panama, Mexico and South America, west side; fortnightly; speed 15 knots; 8,000 tons gross or over.
13. From an Atlantic port to Europe; weekly; speed 22 knots; 20,000 tons gross or over.

Would Mean Many New Ships.

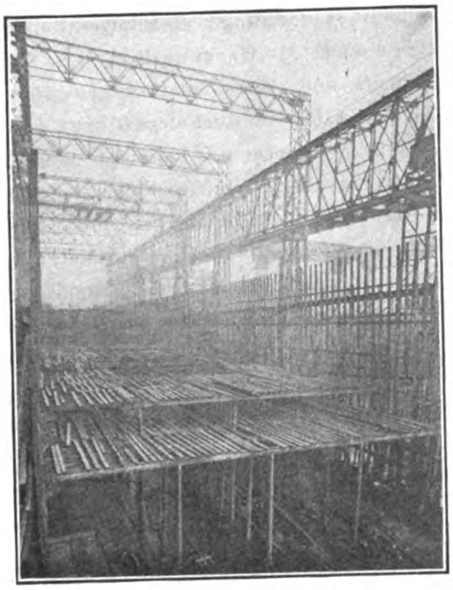
These lines would require about 300,000 tons register of steamships, about 250,000 tons of which would have to be built. Compared to what we annually expend on our navy the expense of this fleet of merchant auxiliaries would be small. These lines would build up a commerce for this country worth many times what it would cost to maintain them. The method of letting out the subsidies as it were to the lowest bidder would secure the required service at the lowest feasible figure and would be fair to all concerned.

I have brought this subject before the Society with some misgivings as to the result. Whatever position any member may hold or take on this subject the importance of it cannot be ignored, and, while I cannot be present to take a part in the discussion which ought to follow the reading of it, I trust that there will be a full and free expression from all my fellow members of their views as to what the government should or should not do for the shipping interests of our country.

THE NEW WHITE STAR LEVIATHANS—OLYMPIC'S FRAME WORK.

It is significant of the interest which the new White Star liners evoke that, although they will not be completed at the earliest till the end of next year, they are already the subject of approving comment. They are to embody, it is clear, all the features of the most noteworthy liners at present under British or foreign flags, and, in addition, are to introduce some novelties of their own. The grill room, the verandah cafe, the roof garden, the ocean flat, the swimming bath, the passenger lift,—these will be among the many provisions showered upon the Atlantic voyager. A ballroom and a skating rink are other innovations which may be looked for in the new liners. There will be much to wonder at and admire in the new liners, but from the point of view of ocean recreation, they will be particularly noteworthy.

By this time it is pretty generally understood that the Olympic and Titanic are not designed to compete with the big Cunarders in point of speed. Twenty-five or 26 knots does not represent an economic pace in the judgment of the White Star line,



S. S. OLYMPIC LOOKING AFT.

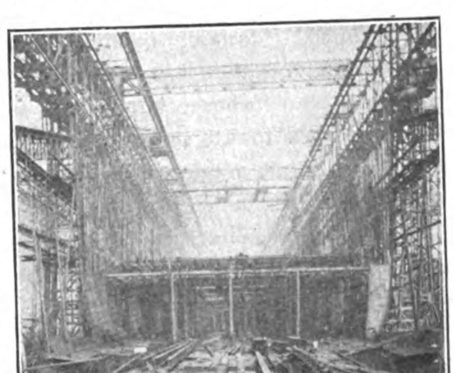
so the new leviathans will take a day or two longer over the Atlantic voyage. The luxurious conditions under which the trip will be made, will, it is held, compensate for the additional time spent at sea. The White Star is applying to the propulsion of these leviathans a combination of reciprocating engines and turbines such as is already exemplified in the Laurentic, also built by Messrs. Harland & Wolff. The completion of the Olympic and Titanic will mean, therefore, that the four biggest liners in the world will not only be under the British flag, but that in each case the turbine will contribute in whole or part to propel them. The White Star mammoths will have Southampton as their home port, and will call at Cherbourg to tap the continental traffic. The detailed dimensions of the ships, however, are still withheld.

We have been favored by the builders, Messrs. Harland & Wolff, Belfast, with two interesting photographs showing the frame work of the Olympic at the end of October. The view is looking aft, and shows the vessel more than half framed. Amidships and forward, the lower deck beams are being placed in position. From the engine room aft the hold columns and deck girders were fitted in conjunction with the framing, to obviate the necessity of the usual wood shoring aft. The question of shoring and staging in these vessels was naturally a more difficult one than usual owing to the great height from the ground at the ends of the vessel, and this has been overcome by the builders by means of a number of light iron lattice-work trestles which they have constructed for staging purposes. The shell plating of the Olympic appears above this upper turn of the bilge, the whole so far having been hydraulic riveted from the keel up. Some idea of the immensity of the work involved in the construction of such a leviathan as the Olympic may be gained by a few statistics. The weight of the rivets in the ship's double bottom alone weigh 270 tons, numbering about 500,000, the largest being 1¼ inches in diameter. The heaviest plate weighs 4½ tons, and is 36 ft. long. The stern frame, which is already in position, weighs 70 tons; the rudder 100 tons, and the boss arms 73½ tons aft and 45 tons forward. The largest beam used tops 4 tons, and measures 92 ft.

OBER AMMERGAU PASSION PLAY 1910.

Great preparations are being made in the little mountain-hidden village of Ober Ammergau, Bavaria, for the production of the Passion Play beginning in May and continuing until the middle of September next year. Many improvements have already been made. Three of the streets leading to the great auditorium have been widened, as has also the plaza in front of the ticket office. A large photographer's studio has been erected next the dressing room and as protection against fire a station has been established in which 21 men are to be detailed. The representations are always given during daylight, without the use of artificial light, making the possibility of fire a most remote contingency. To care for visitors who may become ill, from any cause, a temporary hospital has been established under the direction of the village doctor with attendants and nurses. Seamstresses have been engaged in making the multi-colored costumes for the past six months. These alone will cost in the neighborhood of $25,000.

The principal roles together with their impersonators, as furnished the North German Lloyd offices in New York, the official representatives of the Passion Play committee of Ober Ammergau, are: Prologue, Anton Lechner; choir leader, Jacob Rutz, who acted in the same capacity in 1900; Christ, Anton Lang, who acted this role in 1900; John, Albrecht Birling; Peter, Andreas Lang; Judas, Johann Zwink, third time; Pilate, Sebastian Bauer, second time, and Magdalene, Maria Mayr.



S. S. OLYMPIC LOOKING AFT.

TOUGH TUNGSTEN LAMPS IN A WRECK.

The collision between a Pennsylvania eastbound passenger train and an empty engine just outside Jersey City on the morning of Nov. 8 resulted in comparatively few injuries to the passengers, due to the fact that the strong frames of the passenger cars resisted crushing. The damage to engines and cars, however, was considerable. One of the steel passenger coaches jumped the track and turned over on its side, denting in the steel plates about 18 inches.

In the lighting equipment of this car were nine General Electric Tungsten lamps. It is interesting to note that, after the wreck, when all the lamps were taken out and tested, the Tungstens were found to be in perfect condition—a further proof of the rather remarkable strength and durability of the Tungsten filament when specially adapted for train lighting service.

LARGEST AMERICAN SAILING VESSEL.

The largest sailing vessel of American registry and the largest wooden vessel ever built in the United States will be launched on Dec. 14, at Bath, Me. The vessel will be named Wyoming, will have six masts and a gross tonnage of 3,730 tons, exceeding the William L. Douglas by 22 tons.

The Canadian Pacific Railway Co.'s steamer Athabasca of the upper lake service is to be cut in two and an additional 36 ft. of length built into her during the coming winter. This work will be done at Collingwood by the Collingwood Shipbuilding Co. and the Athbasca is to be completed and ready for service on the opening of navigation next spring.

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ERRATUM.

In the article on The Naval Waste the words "three and one-half times the total stock of gold and silver," etc., on page 503, should read "over double the total stock," etc.

THE REORGANIZATION OF THE NAVY.

Circulars which have been issued by the navy department explaining the loudly heralded reorganization scheme to which the navy has been driven by the continued undisputable charges which have been made upon it chiefly through the columns of THE MARINE REVIEW, show that the plan, after all, practically amounts to nothing more than an opportunity to get Mr. Meyer in the public eye. The circulars themselves confirm in explicit terms the charges as actually made, as will be shown later. Briefly the plan inaugurated by Secretary Newberry in December last, and which it will be remembered was received with a perfect storm of opposition and criticism from subordinates in the department, has been confirmed and expanded. The steps taken by Newberry were the first taken in two generations looking to any improvement, and considering the general defamation of their author when they were first put into effect, he may be excused for smiling at the latest "reorganization," which may be tersely described as a pure and simple fake. Secretary Meyer, feeling the need, he says, for extra advice, has constituted, "tentatively," an advisory board of four officers of high rank, who will be known as the Aids for Material, Personnel, Operations and Inspections, which titles indicate sufficiently clearly the line of duties of each. The Bureau of Equipment is to be abolished and its duties divided amongst the other bureaus, who remain to plague us and the present as well as succeeding administrations. Practically, then, the only change which has been made in the entire system is the addition of a board of line officers armed with boundless power as well as with the inclination to stir up further mischief. For instance:

> The officers so detailed must be proficient in their own subjects and their tenure of office must depend upon the quality of their advice and the success or failure which results.

A line officer is to be the Aid on Material, which covers the entire field of technical design, building and maintaining of the fleet. There is no one man whose knowledge is broad enough to fill such a position, and least of all a line officer or any other educated in or for the navy. The idea is visionary and impracticable, even ridiculous. So too, in less degree, with the others. The aim is, as set forth in the circulars, to secure advice for the Secretary which will be responsible. How in the world can an aid be responsible when he himself lacks knowledge of the subject and when he has no control over those whose duties are to carry out the suggestions and recommendations of this board. It is merely another instance of the fatuity with which succeeding secretaries allow themselves to be guided by the line officers and others securely entrenched officially in the department. So much for the new. Now let us note how the department, which has protested and denied and stormed over the thrusts so effectively made by THE REVIEW, has changed front and apparently expects thereby to shut off further criticism.

> The annual appropriations for the navy have reached such an amount that the most economical and efficient administration is necessary to get the full benefit of the money expended. The best business methods are necessary to prevent waste and secure efficient results.

And again:

> The present organization of the department is not such as to permit of the business being done economically or efficiently.

And:

> It is in the navy yards that most economy in the expenditure of public money seems to be possible.
>
> In the past very little method has been provided for the use and employment of the fleet.

It is probable that the Secretary did not have the opportunity to edit the foregoing and other eminently gratifying clauses of the new program, or they would have assumed another tone. They justify every charge that has been made.

The Newberry plan, which is liberally commended, is referred to in part as follows:

> The essential feature of the Newberry plan was consolidation, which, as was to be expected, was largely successful.
>
> On the whole the scheme was in the right direction but it failed to fully recognize that a navy yard is not a commercial manufacturing plant, but a repair plant existing only for the fleet.

So if Newberry had further noted one of the things so steadily contended for in THE REVIEW, the inference is that his plan would have been flawless. Mr. Newberry continued the building of vessels in navy yards when he should have recognized that a navy yard is not a manufacturing plant, but merely a repair plant. The building of vessels in navy yards, therefore, will doubtless be discontinued.

One more point and we will leave the subject for the present. The "reorganization" contemplates the establishment of a "modern and efficient cost system."

> When this system is established at all navy yards, their work can be compared with similar work of outside firms.

THE REVIEW takes this opportunity to assert that the department will

not do and has no intention of doing anything of the kind. There will be no cost system which will give the slightest indication of cost beyond possibly the labor pay roll and material invoices, and there will be no effort to establish anything more complete. There will be no items of overhead expense, salaries of line and bureau officers, interest on investment, taxes, insurance, depreciation, inspection, postage and telegrams, legal expenses, repairs and maintenance, or profit on product, and any so-called cost system which does not show these charges in comparison with outside firms, with every one of which they are and must be taken into account, is nothing but a swindle and will fool no one but the department.

The leopard will not change his spots and the navy will continue a festering sore until it is starved out and its reorganization undertaken by others than itself or by secretaries who have something more in the way of practical business knowledge than the record of having held a few political offices and of having had a place in the lists of directors of a few banks and trust companies. Military administration of navy yards and shore offices and equipment never did and never will achieve anything but failure in so far as results for money expended are concerned.

A BRITISH VIEW OF OUR MERCHANT MARINE.

Latterly English periodicals have been paying some attention to the revival of the American merchant marine and are making some pertinent remaks upon the subject. Especially is this so of the *Naval and Military Record* of London, which quotes Lord Brassey as saying that a navy unless backed by a mercantile marine is a hot house plant that cannot endure. It quotes also the following notable sentence in President Taft's speech at Seattle:

> Were we to go to war today our merchant marine lacks altogether a sufficient tonnage in the auxiliary unarmed ships absolutely necessary to the proper operation of the navy; and we should have to purchase such vessels from foreign countries, and this, under the laws governing neutrals, might be most difficult.

The *Naval and Military Record* finds that the danger referred to by the President was illustrated throughout the voyage of the United States Atlantic fleet when it was found necessary to charter a number of British and other foreign colliers. That foreign powers should clearly recognize our weakness is a most humiliating fact.

Commenting upon the decline of the American merchant marine, this periodical says:

> With the advent of iron ships the high prices of that commodity in the States, plus the high cost of labor, rendered it inevitable that ship building should cease to pay, and that is precisely what happened. As far back as 1870 President Grant appealed in vain to congress to stimulate the rebuilding of the merchant marine and five later presidents failed. The decline dates from 1861, in which year the tonnage of American registered vessels amounted to upwards of 6,000,000 tons or nearly equal to the British tonnage. In President Grant's time it sunk to about 1,500,000 and in 1905 it was below 1,000,000 tons. The persistent refusal of congress to subsidize lines of steamships is generally held to be the main cause of the failure to recover the lost trade. The merchant marine is the one unprotected industry in a rigidly protected country. Germany has shown the world how a mercantile marine can be built up and stimulated by subsidy, and this is the remedy which President Taft would apply. All his predecessors have failed during forty years, but there are some indications now that congress may alter its views.

That is a fair statement of the case. All that the advocates of the upbuilding of the American merchant marine are contending for is assistance to equalize the handicaps imposed upon it by the country's fiscal policy.

Continuing the *Naval and Military Record* says:

> In these circumstances it can hardly be doubted that the United States will sooner or later determine to create a merchant marine such as will enable them to profit by the opening of the Panama canal.
> It is amazing that congress has barred the way to the revival for forty years, but we cannot expect the attitude to endure. The British carrying trade stands to lose by the almost inevitable revival of the American marine. It will be seen, too, that the President has advanced a very strong argument in dwelling upon the intimate relations between a powerful navy and the national marine of training ships.

During the sailing era the British admiralty made a sort of naval reserve of the whole merchant service, freely "pressing" all merchant seamen that were needed in time of war. Obviously these tough mariners were converted into efficient fighting men after a few months of active service. This policy, of course, is not possible today, "pressing" having gone entirely out of fashion. Moreover, the training of a modern man-of-war's man is infinitely more complex than it was in the sailing days. The introduction of long service into the British navy has altered the system, though a royal naval reserve of 26,000 men is still maintained.

War, however, always makes a close bond of union between the navy and the merchant marine. The navy will always need in times of war hundreds of merchant vessels to accompany the fleet. Britain wisely never loses sight of this fact. The United States displays its folly by overlooking it altogether. It is creating a great navy without its necessary auxiliaries and without which its war ships are about as formidable as painted ships upon a painted sea.

AN ENLARGED FIELD FOR THE SPEED-REDUCING GEAR.

When Melville & Macalpine set themselves the task of devising a suitable speed reducing gear to bridge the gap between the desirable high rotative speed of the turbine on the one hand, and the relatively slow speed at which the propellers for merchant ships are most efficient on the other, they doubtless did not realize that their success would in all probability merely facilitate the progress of the steam driven motor to the rear, and yet such would seem to be the case. There can exist scarcely any doubt that steam as a source of power must inevitably give way to gas. Economy of fuel alone will enforce the adoption of the latter, while the reduced weights due to lessened fuel consumption and the replacing of heavy boilers and boiler room equipment by comparatively light gas producers and the elimination of condensers, large evaporating and distilling plants at sea, and much of the pumping equipment, together with entire absence of smoke and reducing maintenance expenses, all will tend to hasten the advent of the one and the supersession of the other.

One of the prime obstacles in the path of the gas engine—in fact the chief, is the difficulty of effecting prompt and certain reversal. Another is the difficulty of achieving the wide range of speed control to which the steam engine lends itself perfectly. To be

sure, both are accomplished in existing designs, but these do not recommend themselves for everyday commercial use. They are satisfactory enough for yachts and torpedo boats, where first cost and fewness of parts and consequent maintenance do not loom so large and manoeuvering ship is a relatively unimportant feature as compared with the merchant service. The weight per horsepower of the larger, slower running gas engine is greater than that of the smaller and higher speed machine, though not greater than of a steam engine under like conditions; and hence the desirability of a higher rotative speed. So here the ideal condition then appears to be a non-reversing engine with relatively high rotative speed; but this does not provide for reversing the propeller, and it is freely admitted by all engineers that the intervention of reversing gears or clutches, or indeed clutches of any form, between the engine and the propeller is not admissible. The obvious solution is electric transmission, and the driving of propellers of fair size by reversible motors at wide speed ranges is already in successful operation, but the large powers and slow rotative speeds employed in the average cargo ship means an enormous increase in size, weight and cost of motors, unless some satisfactory reduction gear may be interposed. An ideal combination would appear to be, then, the double-acting combustion engine, direct connected to an electric generator and running at constant speed, with comparatively small medium speed reversible motors driving the propellers at the most efficient speed through a speed reducing gear. With this combination, the non-reversible engine becomes available, and its size and weight enormously reduced and the difficulty hitherto encountered in direct connected motors for such propeller speeds as are admissible in merchant ships is surmounted. The engines, moreover, would realize ideal full load economy and thus take fullest possible advantage of the thermal superiority of the gas producer and combustion engine.

Objection has been raised to the speed reducing gear referred to on account of the alleged risk of breakdown from shocks to gear teeth in a seaway. This we do not think to be well founded. Aside from the fact that there is not a three-high rolling mill which is not gear driven,—and if there is any service subject to greater shocks it does not occur to us,—the damage caused to propellers or shafts by the shocks of heavy weather is very slight indeed. Propellers and shafts fail, it is true, and sometimes fail when weather conditions are unfavorable, and will probably continue to do so, but chiefly from other causes. More shafts fail from continually changing bending strains, from unequal turning effort, and from deterioration due to galvanic action, than from shock, and the use or non-use of a speed reducing gear will not affect these conditions a particle. As a matter of fact there is little or no shock to the propeller or shaft in heavy weather. The strain is variable, it is true, but it can in no case be greater than that due to transmitting the full power of the engine to a fully immersed propeller. It is not comparable even with that sustained by almost any engine working in steel mills, power plants or other situations where the momentary change in load may be almost anything within the maximum capacity of the machine. We recall, not one but several, instances of large, coarse pitched gears, without any pretense to close fitting, which have stood up to their work continuously for 20 years or more, and every winter during that period have sustained months of pounding in such ice navigation as is not found anywhere else within our knowledge. There are numerous more probable risks of breakdown and more imminent dangers aboard any ship than the gear drive proposed by Melville & Macalpine, but no one ever gives them a thought.

LORD, HOW LONG?

As the days go by the proofs accumulate that the navy department is not only working for the utter extinction of the American Merchant Marine but has neither respect for the promises and statements of its own acting secretary nor the slightest regard for the opinions of the press or the public. In the November number of the REVIEW we dealt with statements given out by Beekman Winthrop at San Francisco regarding the shipments of coal to the Pacific coast in foreign ships in which he promised there would be no more. He further said that the new colliers which the government has just had built would be used before other ships would be chartered. As we go to press comes the information that the department has broken out again and has chartered a Strath Line (foreign) steamer for coal from the Atlantic to the Pacific coast.

We have repeatedly called attention to this naval collier business; pointed out the sheer useless waste of money in their construction; we have stated that the department would not use them when they had them and we have questioned not only the good faith but also the actual knowledge behind every statement that Winthrop has made on the whole subject, and in no single instance have we been at fault. If ever there was a question that needed the most searching investigation it is this collier and eastern coal business. There is something wrong and a probe might find it out.

TREATMENT OF LABOR ON THE LAKES.

It has been repeatedly stated in these columns that nowhere in the world is labor so well treated as on the great lakes. Nowhere are they better housed, better fed, or better paid. One has only to compare wages and conditions obtaining elsewhere to realize how true this is. During the past year the Lake Carriers' Association has evolved a plan known as the Welfare Plan for promoting the joint interest of employer and employed and to cement and consolidate the various elements aboard ship into one harmonious family.

During the year this plan has grown steadily in favor until it embraces altogether over 9,500 members and has now reached such a stage of permanency as to warrant the projection of a Sailors' Institute at an ap-

proximate cost of $350,000. This institution will be located in the city of Cleveland. The institute is to be provided with reading rooms, writing rooms, billiard rooms, gymnasium and assembly rooms in which meetings can be held and classes in engineering and navigation conducted during the winter. A branch bank will also be established in institute in connection with one of the leading banking institutions of Cleveland. A limited number of sleeping rooms will also be provided. The committee actively at work on the institute project consists of Samuel Mather, E. W. Oglebay, W. G. Pollock, H. Coulby, D. R. Hanna, Gen. George A. Carretson and J. H. Sheadle.

Under the rules of the Welfare Plan certificates or cards are issued to employes regardless of union affiliations. They are issued for one year so as to cover the season of navigation, and are accompanied by a discharge book which is deposited with the master or chief engineer of the steamer upon which the holder of the card is employed. This book is returned to the holder at the close of the season with a statement of the character of service rendered.

The holders of these certificates are also beneficiaries in an emergency benefit system should any accident befall them in the line of duty. This benefit is of immediate application and is bestowed even before an investigation into the causes of the accident are made, and without impairment of any legal right to a greater sum. The benefits range from $500 for a master to $75 for an ordinary seaman.

The Welfare Plan is generous and imposes no restrictions whatever upon its members. All that is asked of them is that they discharge their lawful duties towards the ship, but certain labor leaders, with that rare fecundity for the propagation of trouble so many of them possess, have characterized the issuance of the certificates as an encroachment upon human rights. Their attitude is simply silly, and would be amusing did it not possess the potentiality for making mischief.

One has but to compare wage scales to discover how well lake seamen are treated. The Cunard liner Mauretania is the greatest piece of marine architecture afloat, but beyond his uniform the master of the Mauretania gets scarcely more than the master of a modern bulk freighter on the lakes. Lake masters get $2,000 per annum with a bonus of $100 to $250 at the close of the season; the master of the Mauretania gets $2,500 per year, and this for 12 months' work as against the eight or nine months for the lake master.

Herewith is published a table showing the relative wages paid to lake seamen and to seamen on salt water ships under American, British and German flags. In each case the master's wages have been omitted from the calculation.

	American				British		German	
	Lake		Ocean					
	No.	Total wages.	No.	Total wages.	No.	Total wages.	No.	Total wages.
Deck officers	2	$211.00	6	$430.00	7	$359.64	6	$221.34
Deck force	10	380.00	45	1.129.58	44	967.14	53	659.99
Engineers	3	370.00	29	1,595.00	25	1,455.57	34	1,069.53
Firemen, oilers and watertenders	6	300.00	136	4,860.75	153	3,676.59	179	2,879.80
Pursers, etc.	..	......	4	242.50	5	230.85	5	138.04
Culinary	..	......	27	680.00	21	493.29	25	486.95
Stewards................	4	182.00	125	2,179.04	162	2,530.36	191	2,156.27
Miscellaneous	..	......	8	189.13	10	177.88	7	406.63
Total	25	$1,443.00	380	$11,306.00	427	$9,891.32	500	$8 018.55

It will be noted that the average wage paid on salt water ships under the American flag is $29.75, under the British flag $23.16, under the German flag $16.08, while on the lakes the average is $57.72, or 94 per cent greater than American ships in the ocean trade, 149 per cent greater than British ships and 260 per cent greater than German ships.

PRESIDENT TAFT ON SHIPPING.

President Taft in his message just delivered to congress urges governmental assistance to shipping in the following words:

> Following the course of my distinguished predecessor, I earnestly recommend to congress the consideration and passage of a ship subsidy bill, looking to the establishment of lines between our Atlantic seaboard and the eastern coast of South America, as well as lines from the west coast of the United States to South America, China, Japan and the Philippines. The profits on foreign mails are perhaps a sufficient measure of the expenditures which might first be tentatively applied to this method of inducing American capital to undertake the establishment of American lines of steamships in those directions in which we now feel it most important that we should have means of transportation controlled in the interest of the expansion of our trade.
>
> A bill of this character has once passed the house and more than once passed the senate, and I hope that at this session a bill framed on the same lines and with the same purposes may become a law.

ITALIAN EMIGRANT SHIP TORTONA.

Messrs. Swan, Hunter & Wigham Richardson, Ltd., have just delivered a new Caird liner, named Tortona, which they have built to the order of Messrs. Cairn, Noble & Co., for service in the Italian emigrant trade to Canada. She is a twin-screw, four-masted passenger and cargo steamer, 464 ft. by 54 ft. 2½ in. by 40 ft. depth to shelter deck, and 8,300 tons dead weight. She has accommodation in the 'tween decks for 1,000 to 1,100 persons, besides accommodation for about 40 first-class passengers. She has been built to the highest class of Lloyds Register, and conforms to the regulations of the British Board of Trade and the American Emigration Laws. In her arrangements for the emigrant trade she has also been built according to the regulation of the Italian government, and in this respect she is certainly thoroughly equipped, nothing likely to conduce to the comfort and convenience of her passengers having been overlooked. A large portion of the 'tween deck space has been insulated for the carriage of perishable cargo, this space being cooled on the cold-air system, while there are further chambers cooled to 15 degrees on the brine-pipe system. The vessel has a complete installation of wireless telegraphy. Her powerful two sets of triple-expansion engines, constructed by Palmers Shipbuilding & Iron Co., Ltd., Jarrow, have cylinders 25½, 41 and 68 by 48 in. stroke, with four boilers, and they developed a speed of 15 knots on the trial trip. It is interesting to add that a sister ship of the Tortona has been ordered from the same builders to be employed in the same trade under the sanction of the Italian government.

Merchant Marine League of California

A BRIEF account of the organization of the Merchant Marine League of California was published in the November issue of THE MARINE REVIEW.

FRANK B. ANDERSON, PRESIDENT MERCHANT MARINE LEAGUE OF CALIFORNIA.

We are now able to present a more complete report of the interesting proceedings at the time of the organization of the California League, together with illustrations.

It was finally decided that the new league should be called the Merchant Marine League of California, not the Merchant Marine League of San Francisco as originally suggested. The annual dues were reduced to a nominal figure ($2.00 per year) in order to give the league weight of numbers. With the scope of the original plans thus enlarged members will be recruited from all over the state of California and the new organization will rapidly acquire prestige and a powerful influence.

As previously published, the Merchant Marine League of California was organized at a dinner given at the Fairmont Hotel, San Francisco, Nov. 1.

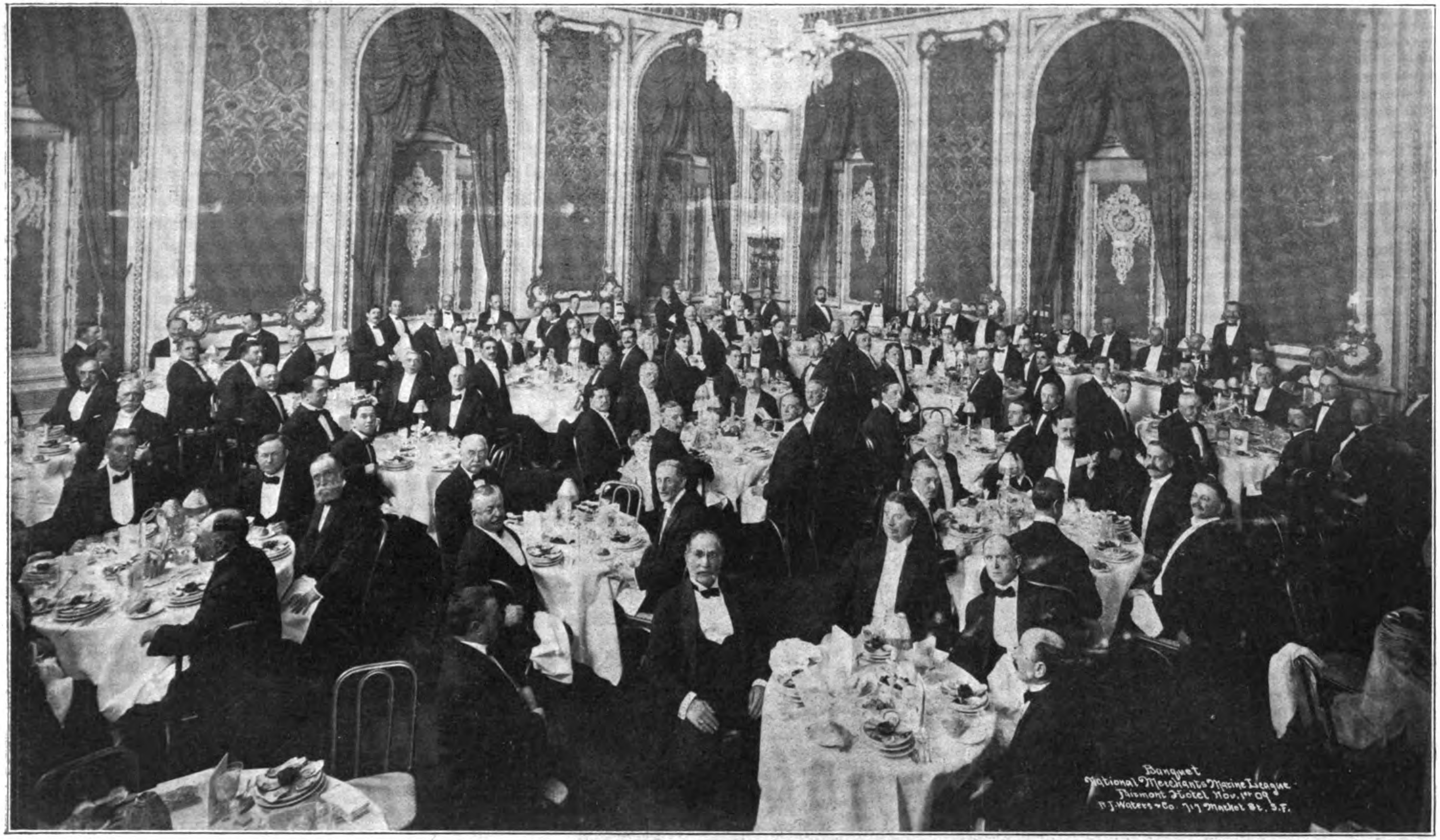
U. S. Senator Geo. C. Perkins was the first speaker introduced by Gov. Gillette. Senator Perkins has had wide experience in shipping affairs and in a telling speech he pointed out how 50 years ago there were ten American ships on the high seas to one foreign, while now there are practically no American vessels engaged in the world's carrying trade; he showed by what a narrow margin the Japanese are kept out of the Hawaiian trade and paid his respects to the abominable policy of the navy department with respect to its shipments of coal to the Pacific coast.

Col. John P. Irish, who followed Senator Perkins, stated that during the Crimean war England was forced to charter American ships to carry troops and supplies. This costly and dangerous experience taught England a lesson which she has not yet forgotten. She immediately adopted the policy of subsidizing her merchant shipping until today conditions are reversed and the United States would have to go to Great Britain for ships. "We have lost our seafaring character, we are no longer a nation of sailors," declared Col. Irish. "We must, therefore, act, and first of all we will have to educate the public to a proper respect for shipping and for seafaring commerce. If talk could build a merchant marine, we would have so many ships that we could walk on their decks dry shod from San Francisco to Yokohama! What we need now is work, action, hustling and lots of it."

Address by Geo. W. Dickie.

Geo. W. Dickie, marine engineer and naval architect, read a carefully prepared paper of great interest. Mr. Dickie has been a prominent advocate of a rational merchant marine policy for a great many years, having made his first address on this subject in San Francisco over 36 years ago. Mr. Dickie's remarks were an excerpt of his paper read at the recent meet-

MR. C. C. HENION,
SECRETARY, MERCHANT MARINE LEAGUE OF CALIFORNIA.



THE DINNER AT THE FAIRMOUNT HOTEL, SAN FRANCISCO, NOV. 1, AT WHICH THE MERCHANT MARINE LEAGUE OF CALIFORNIA WAS ORGANIZED. SEATED AT THE SPEAKER'S TABLE, READING FROM LEFT TO RIGHT, ARE C. C. HENION, COL. GEORGE PIPPY, CONGRESSMAN E. A. HAYES, GEORGE KNIGHT, R. P. SCHWERIN, JOHN P. IRISH, JOHN A. PENTON, GOVERNOR GILLETT OF CALIFORNIA, SENATOR GEORGE C. PERKINS, HENRY T. SCOTT, M. H. DE YOUNG, HARRIS WEINSTOCK AND GEORGE W. DICKIE.

COL. GEORGE H. PIPPY, VICE PRESIDENT FOR THE STATE OF CALIFORNIA OF THE MERCHANT MARINE LEAGUE OF THE UNITED STATES.

ing of the Society of Naval Architects and Marine Engineers which will be found elsewhere in this issue.

As reported in the November issue, comprehensive speeches were also made by Harris Weinstock, R. P. Schwerin, Henry T. Scott and John A. Penton. Mr. Weinstock covered the economic phases of the question with unusual thoroughness and Mr. Penton, with characteristic energy, reviewed the accomplishments of the Merchant Marine League of the United States and pointed out the work yet to be done.

Every phase of the subject, economic, patriotic, commercial and military, was thoroughly covered at the San Francisco meeting and it is doubtful if a more representative body of business men had ever before assembled in California for the futherance of a common object.

ANNUAL REPORT OF COMMISSIONER OF NAVIGATION.

The commissioner of navigation reports to Secretary Nagel of commerce and labor that the total documented shipping of the United States on July 1, 1909, comprised 25,688 vessels of 7,388,755 gross tons—a larger tonnage than under any foreign flag except the British, 18,800,000 tons. American shipping is almost wholly engaged in domestic commerce and 6,501,250 tons are enrolled or licensed for this purpose, while Germany's 4,266,000 gross tons are almost wholly of course in foreign trade. American tonnage registered for foreign trade amounts to only 887,505 tons, a loss of 53,000 tons since last year, and much of the tonnage yet registered is permanently laid up. The great lakes employ 2,782,481 gross tons.

During the fiscal year shipbuilding shared in the general business depression here and abroad, and only 1,247 vessels of 238,090 gross tons were built, the smallest amount since 1898. In Great Britain, however, shipbuilding also declined from 1,580,000 tons to 914,000 tons. Prospects and contracts show a decided improvement in shipbuilding at home during the current fiscal year.

Tonnage duties amounted to $1,052,374, a decrease of $24,197. American ships paid $80,397, British ships $595,737, German ships $149,879. We paid British and German ships for carrying our mails, however, more than these amounts. The exemption of vessels in fresh water trades from tonnage tax is recommended. Under the new tariff law, five foreign built yachts have paid $35,854 taxes since September. The constitutionality of the law has been questioned by some yacht owners, and awaits judicial determination.

Shipping commissioners shipped and discharged 341,980 men (counting repeated voyages) on American ships. Only 49 per cent of the crews of these ships are American citizens, born or naturalized.

Laws enacted in 1895 when motor and power boats were practically unknown prescribe equipment unnecessary on the smaller types of these boats, and modification of these laws is recommended.

A bill requiring wireless apparatus on ocean passenger steamers is favored. The report recommends various changes in the navigation laws, but is principally devoted to a consideration of the subsidy question.

A despatch from Halifax, N. S., states that in order to meet the demands for raw material which the enlargement of their plant now in progress will entail, the Dominion Iron & Steel Co. have decided to place an order in England for two 10,000 ton steamers for delivery about a year hence. The new steamers will be specially designed for carrying ore from Wabana mines to the plant at Sydney, C. B., and will be equipped for expeditious loading and discharging.

In recommending a naval program for next year Secretary Meyer will ask Congress to provide for a repair ship equipped with a complete machine shop for all emergencies. The repair boat would have a speed equal to the fastest battleship afloat, so that in all cases it could keep with the fleet.

Delaware and North Dakota

THE trials of the two latest battleships for the United States navy again serve to draw attention to the apparent anomaly in results when comparisons are drawn between turbine and reciprocating engine driven ships. It is the case of the Lusitania over again. That the propeller efficiency of the reciprocating engine driven ship is higher than that of the turbine is not debatable; hence the steam consumption per effective horsepower is lower, although, measured in terms of shaft horsepower, the turbine may appear to have somewhat the best of the argument. The trials show both ships to be highly efficient machines and the results as nearly alike as could possibly be expected, and considering each ship as a whole the performance at the higher speeds probably agreed as closely as though the two ships had been identical in all respects and from the hands of the same builders, as an inspection of numerous other trials of identical ships will bear witness. The ships are 510 ft. in length, 85 ft. beam, trial draught 27 ft. The North Dakota was built by the Fore River Shipbuilding Co., Quincy, Mass., and the Delaware by the Newport News Shipbuilding & Dry Dock Co., Newport News, Va. Both companies are proud of their product, and the press has been filled with conflicting statements regarding the trials. THE REVIEW is able to present the statements of both companies.

Statement of the Fore River Co.

TRIALS OF NORTH DAKOTA.

	3 hours of full power trial.	24-hour trial at 19 knots.	24-hour trial at 12 knots.
Actual average speed	21.64	*19.24	12.05
R. P. M.	280.4	231.9	143.2
Shaft H. P. of main turbines	31,400	*16,710	3,800
I. H. P. of engineer's auxiliaries	1,100	*660	400
Water rate of main turbines only	13.6	14.11	20.5
Water rate for all engineer's purposes, based on total H. P.	13.96	15.29	22.3
Coal used, pounds per hour	54,400	*27,550	9,820
Coal used, tons per 24 hours	583	295.3	105
Coal per hour per shaft horsepower of turbines	1.74	*1.65	2.58
Coal per hour per horsepower for total horsepower	1.68	*1.58	2.34
Coal per hour of equivalent I. H. P., based on 8 per cent friction for reciprocating engine	1.55	*1.46	2.15

* Unofficial.

STANDARDIZATION TRIAL.

Highest speed on mile, uncorrected for tide, knots	22.25
Mean of five high runs, knots	21.83
R. P. M. for 21 knots	263
R. P. M. for 19 knots	228.8
R. P. M. for 12 knots	142.5
Maximum shaft horsepower developed on mile	35,150

"It should be noted that the coal consumption of the North Dakota on the high speed test is for a somewhat higher speed than the Delaware, and that for small increases of speed near the maximum the coal consumption rapidly increases. It should be further noted that the higher top notch speed of the North Dakota permits her to reach her destination quicker than the Delaware.

"The above speeds and coal consumption are determined by the Trial Board of the Navy Department.

"The steaming radii of the vessels are computed from these official figures and from the fuel capacity of the vessels. As the fuel capacity of each vessel is the same, and as the coal consumption of the North Dakota is less, it is quite evident that her steaming radius is greater. There can be no better criterion of the actual abilities of two vessels than shown by the results of the official acceptance trials.

COMPARISON.

	North Dakota.	Delaware.
Fastest run over measured mile	22.25	21.98
Average of five high runs	21.83	21.44
Full power trial speed	21.64	21.56
Full power trial, H. P.	31,400	28,600
Full power trial, coal consumption, tons, per day.	583	578
19-knot trial, coal consumption, tons, per day	295	315
12-knot trial, coal consumption, tons, per day	105	111

"An inspection of the above table shows at once that the North Dakota developed a higher speed than the Delaware on all the high speed trials and has the highest speed on the measured mile, the highest average for the five high speed runs and developed a higher speed during the full power trials.

"The table also shows that the North Dakota was the most economical vessel on both nineteen and twelve knot runs, burning twenty tons less per day on the nineteen knot run and six tons less per day on the twelve knot run, and on the full speed test, although the coal consumption of the Delaware is slightly less the speed of the North Dakota is higher."

Statement by the Newport News Co.

"During the standardization trials of the Delaware on Oct. 23 the speed of the fastest run on the measured mile was 21.664 knots. The average of the two highest runs over the measured mile was 21.623 knots. The average speed for the five high speed runs was 21.444 knots. The speed one way over the measured mile during standardization runs is no indication of the ship's speed, on account of the varying influences of the tide. These standardization runs of the Delaware were made at as nearly uniform speeds as possible in order to secure reliable curves, and the ship was not forced during the runs.

Trials of Delaware.

FULL SPEED, FOUR-HOUR TRIAL, OCT. 23, 1900.

Speed, knots	21.563
I. H. P.	28,578
Coal consumption, per hour, tons	24.05
Steam consumption of main engines per H. P. per hour, lbs	13.12
Steam consumption for all purposes per H. P. per hour, lbs	14.56

"The speed for the twenty-four hour nineteen knot trial was 19.225 knots and for the twenty-four hour twelve knot trial was 12.275 knots. In order that a comparison between the performances of the two ships may be made on the same basis we give below the principal data for the Delaware at even speeds of 21, 19 and 12 knots respectively:—

AT 21 KNOTS.

Coal, tons, per hour	19.2
I. H. P.	23,600
Steam consumption, main engine, per I. H. P. per hour, lbs	13.05
Steam consumption, all purposes, per I. H. P. per hour, lbs	14.5
Amount of steam used by main engines per hour, tons	137.5
Amount of steam used by all machinery per hour, tons	152.8

AT 19 KNOTS.

Coal, tons, per hour	11.6
I. H. P.	14,560
Steam consumption, main engines, per I. H. P. per hour, lbs	12.92
Steam consumption, all purposes, per I. H. P. per hour, lbs	14.85
Amount of steam used by main engines per hour, tons	84
Amount of steam used by all machinery per hour, tons	96.6

AT 12 KNOTS.

Coal, tons, per hour	4.3
I. H. P.	3,520
Steam consumption, main engines, per I. H. P. per hour, lbs	15.7
Steam consumption, all purposes, per I. H. P. per hour, lbs	21.6
Amount of steam used by main engines per hour, tons	24.6
Amount of steam used by all machinery per hour, tons	34.0

"During the trials of the Delaware the feed water heaters were not in use owing to a leak in one of the joints. This necessitated pumping cold water into the boilers during the trials and caused an increase in the amount of coal consumed.

"The Delaware and the North Da-

kota are sister ships in all respects except the main propelling engines, the Delaware being fitted with the reciprocating type of engine and the North Dakota with the Curtis marine steam turbine.

"If a fair comparison between the different types of engines installed on the two ships is to be made it should show the results from the steam consumed by the engines, and all other factors and influences should be arranged so this result can be obtained. In other words, if the reciprocating engines on the Delaware use less steam per hour than the turbines on the North Dakota when the ships are run at the same speed then the economy of the Delaware's propelling machinery is better than that of the North Dakota. This result is not indicated in the same way by a comparison of the coal consumption, because other factors are then introduced which do not confine the comparison to the engines only.

"This comparison cannot be made on a basis of the amount of steam per horsepower, because the horsepower for a given speed is much less on the Delaware than on the North Dakota on account of the better efficiency of the Delaware's propellers, made possible by the use of reciprocating engines. The comparison must, therefore, be made on a basis of the amount of steam consumed per hour at a given speed, and for this reason we have tabulated the amount of steam in tons used by all machinery in operation, per hour, for the different speeds. A comparison of these figures with those obtained from the trials of the North Dakota show a less consumption of steam for the Delaware at all speeds than for the North Dakota, this difference being about 35 per cent at twelve knots."

The following comparative table is supplied by the Bureau of Steam Engineering, and shows the comparative steam performances of both ships reduced to a common speed basis. At the cruising speeds the difference between the two ships is not only marked but striking:

DELAWARE.			
Water per I. H. P. per hour, main engines only	12 knots. 15.48 lbs.	19 knots. 12.7 lbs.	21 knots speed. 12.9 lbs. water.
Water per I. H. P. per hour, all purposes	12.24 knots. 21.03 lbs.	19.225 knots. 14.52 lbs.	21.563 knots speed. 14.8 lbs. water.
Total water per hour, all purposes	12.24 knots. 83,463 lbs.	19.225 knots. 250,549 lbs.	21.563 knots speed. 422,931 lbs. water.
Total water per hour, for main engines only	12 knots. 55,000 lbs.	19 knots. 205,000 lbs.	21 knots speed. 312,000 lbs. water.
NORTH DAKOTA.			
Water per S. H. P. per hour, main turbines only	12 knots. 20.6 lbs.	19 knots. 14.25 lbs.	21 knots speed. 13.8 lbs. water.
Water per S. H. P. per hour, main turbines and engines' auxiliaries	12.1 knots. 23.94 lbs.	19.245 knots. 15.92 lbs.	21.64 knots speed. 14,408 lbs. water.
Total water per hour, main turbines and engines' auxiliaries	12.066 knots. 90,984 lbs.	19.245 knots. 266,761.1 lbs.	21.64 knots speed. 459,965 lbs. water.
Total water per hour for main turbines only	12 knots. 76,000 lbs.	19 knots. 23,800 lbs.	21 knots speed. 349,000 lbs. water.

A comparison of the powers of the two ships at practically the same speed is of interest. At 21.6 knots the shaft horsepower of the North Dakota is given as 31,400 and of the Delaware at 21.56 knots the indicated horsepower is stated as 28,578. Allowing 88 per cent mechanical efficiency for the engines on the Delaware, or in other words, 12 per cent for friction losses, the shaft horsepower will be roughly 25,150 as compared with the 31,400 of the North Dakota, so that for power actually delivered to the propellers the efficiency of the latter is practically 25 per cent higher in the case of the Delaware than of the North Dakota. This difference in propeller efficiency is observable to a greater or less extent between all turbine and reciprocating engine driven ships, though seldom in so marked a degree.

NEW STERN WHEEL TOW BOAT.

Joseph Supple, shipbuilder, Portland, Ore., has taken a contract for the construction of a wooden stern wheel towing boat for the Willamette & Columbia River Towing Co. The machinery, irons and chains from an old hull will be used in the new boat. The complete boat will represent a value approximating $34,000.

The hull is 160 ft. long, 33 ft. beam with 7 ft. depth of hold. The frames are double, flitch sawed fir, 4 in. square set 22 in. on centers. The propelling machinery is set on oak foundations with steel I beams used in place of engine timbers. Oak lumber is used generously in all places of special strain or wear. This makes one of the staunchest hulls on the Columbia river. The engine cylinders are 19 in. in diameter by 84 in. stroke, stern wheel type. The boiler is of the fire box type, burning crude oil for fuel. The hull is modeled on fairly fine lines forward so that the boat will make good time when running light.

General Shipbuilding Conditions at Portland.

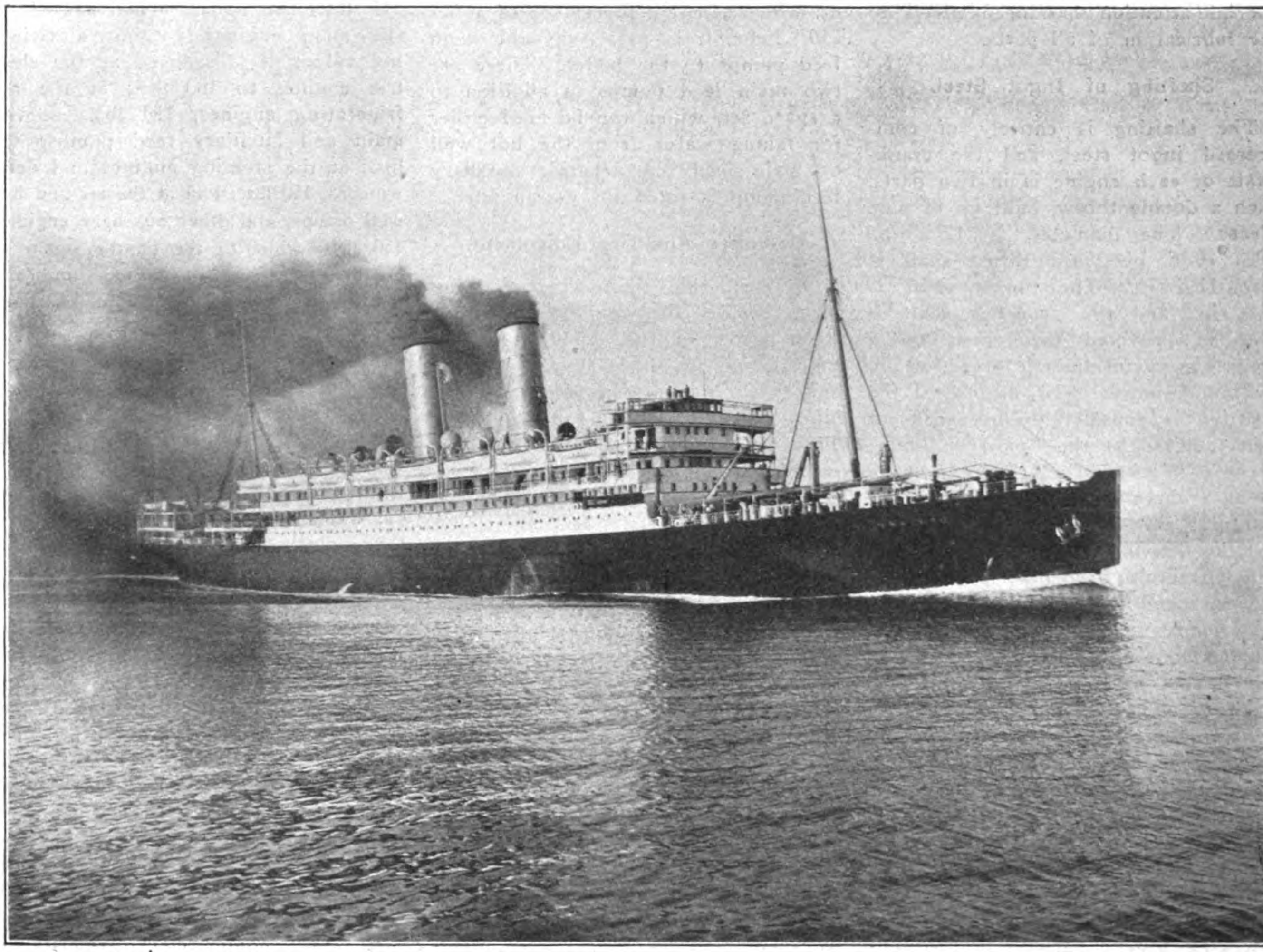
Commenting on general business conditions at Portland, Ore., Mr. Supple says: "Aside from this contract and a regular run of repairs on small craft and barges, work in the yard is scarce for this season of the year. I hope that business will pick up after the first of the year. There will always be some demand for wooden boats and always some repairs to be made. Thus, while there is a great tendency toward steel construction, the days of the builders of wooden craft are not yet numbered."

CATALOG OF WATER TUBE BOILERS.

An attractive catalog describing a new type of water tube boiler has been issued by the Ballin Water Tube Boiler Co, of Portland, Ore. The catalog consists of 29. 5 by 7 in pages, with a large number of drawings and photographs showing in detail the construction of the Ballin water tube boiler. The first boiler of this type was installed in the high speed passenger steamer H. B. Kennedy, where it has given continuous service under trying conditions for over seven months. The boiler was completely described in THE MARINE REVIEW, Oct. 1909. The catalog contains considerable engineering data, tables and formulae bearing on the proper selection of boilers for marine service.

The new tug M. P. Howlett, launched at Wilmington, Del., last week for M. P. Howlett of Philadelphia, has been towed to New York for her engines and boilers which will be put in place by the Waters, Glodersleе Calver Co. at Staten Island.

The Boston-Galveston steamship service will be inaugurated on Dec. 1. The service will be given jointly by the Mallory and Clyde lines and there will be weekly sailings. Four vessels, two from each line, will constitute the fleet.



NEW ORIENT LINER ORVIETO.

Another New Orient Liner

MESSRS. Workman, Clark & Co., of Belfast, have just completed the twin-screw steamer Orvieto, the second of the new orient liners built by them to the order of the Orient Steam Navigation Co., Ltd., to carry on the new Australian government mail service to Britain which comes into force on Feb. 1, next. This vessel, the Orvieto, is a sister ship to the Otranto, completed by the same firm in July last. In addition to these two vessels there were also built on the Clyde three vessels of similar design also for the same service. The general dimensions of these ships vary very little, those of the Belfast built ships being as under: Length over all, 552 ft.; length between perpendiculars, 535 ft.; extreme breadth, 63 ft. 10½ in.; depth from shelter deck, 42 ft.; gross tonnage, 12,124 tons; mean measurement displacement, 15,250 tons; mean service draught, 24 ft. 6 in.; total cargo capacity, 257,880 cu. ft.; and deadweight capacity, 6,100 tons. They have accommodation for 235 first class, 195 second class, and 666 third class passengers. For the saloon passengers there is provided a large and luxurious lounge, and an exceedingly handsome drawing room. The third class passenger accommodation is of a character undreamed of but a few years back. These passengers will enjoy the privacy of separate cabins, many of which contain only two berths, and they also have excellent dining saloons, music rooms and smoking rooms. It may be mentioned here that the voyage is to be shortened after January next by two days under the new contract which the Australian government has made with the Orient line.

Propelling Machinery.

The propelling machinery was designed for all of the ships to give a speed of 18 knots, with a mean service displacement of 15,000 tons, and to run for 24 hours at not less than 16¾ knots with a coal consumption not exceeding 1.4 lbs. per horse-power-hour. The high pressure cylinder is 28¾ in. in diameter; the first intermediate, 41 in.; the second intermediate, 58½ in.; and the low pressure 84 in.; the stroke in all cases being 60 in.

Each cylinder is fitted with a hard, close-grained cast iron liner, forming, with the outer case, a steam jacket. The cylinders and working parts are arranged on the Yarrow-Schlick-Tweedy system of balancing, with the high-pressure and low-pressure cylinder forming the first couple, and the second intermediate and first intermediate the other couple, the valves being on the outside of each pair. These valves are of the piston type for the high-pressure and first intermediate cylinders, and of the double-ported slide type for the second intermediate and low-pressure cylinders. There are no auxiliary engines worked from the main engine, and the condenser is in all cases entirely separate. The construction of the columns may be noted. These are spread so as to give greater rigidity and permit easier access. The main bearings are extra long, and

special attention has been given to the lubrication of all parts.

Shafting of Ingot Steel.

The shafting is entirely of compressed ingot steel, and the crankshaft of each engine is in two parts, each a double throw, built up of nine pieces. The diameter is 17½ in., with 18-in. pins; the thrust shaft is also 17½ in. The tunnel shaft is 18¾ in., and the propeller shaft is 17¾ in., covered throughout by a solid gun metal lining, forced on by hydraulic power. In all cases the shafting is considerably in excess of that required by the Board of Trade. Messrs. Workman, Clark & Co. have fitted a three-bladed propeller to the Otranto, and a four-bladed propeller to the Orvieto. The diameter of the Otranto's propeller is 18 ft. 6 in., arranged for variations in pitch between 22 ft. and 25 ft., with an expanded area of 90 sq. ft., and a projected area of 71 sq. ft.

The condensers are separate plants, and are placed immediately at the back of the main engines. The air pumps and all other pumps are also separate. This separation was adopted not only to assist in the balancing of the engine, but to increase their reliability in maneuvering, as, with the pumps worked separately, there can always be a vacuum in the condenser independently of the action of the main engines, so that the engines start more easily from a state of rest. The condensers are built up of steel plates, and have solid-drawn brass tubes, the water circulating through the tubes. The main air pumps are Weir's duplex type, each with two 9½-in. steam cylinders, 26-in. water cylinders, and a stroke of 18 in. The condensed water from each condenser is discharged into hot well tanks, one on each side of the engine room, the temperature being about 110°, whence it passes through duplex filters. Filters are used of the List and Munn's gravitation type to the hot well pumps. In order further to keep the boilers clear of oil, grease extractors have been fitted to the auxiliary exhaust steam circuit, the grease from the numerous auxiliaries and deck machines being a frequent source of trouble in such ships. These extractors deal with the exhaust from all engines in use when the ship is in harbor — windlass engines, winches, cranes, etc., so that the main filters can then be opened up and cleaned. From the filters the water is pumped by a Weir hot well pump, discharging into a Weir direct-contact feed heater, whence, at a temperature of about 210° Fahr. it is passed by the main feed pumps to the boiler. There are two main feed pumps in addition to a spare set, which can be used either for taking water from the hot well or main feed. A separate auxiliary feed pump is fitted for use in port.

Complete Auxiliary Equipment.

On each ship there is a distilling plant besides the ample storage for fresh water in the double bottoms, with a capacity of 7,000 gal. per day, and two evaporators with a combined capacity of 80 tons per day. The other auxiliary machinery is very complete, comprising the usual centrifugal circulating pumps, ballast pumps, and fire and bilge pumps. A point of interest is that one of the bilge pumps—which are placed between the two thrust shafts—is driven by an electric motor through worm gearing, the pump itself being of the three-throw plunger type, of a capacity of 60 tons per hour, while the other is of the usual duplex design. On the port wings there are also two sanitary centrifugal pumps, which are electrically driven. They have each a capacity of 12,000 gal. per hour, and as they are in constant use while the ship is at sea, the adoption of electric power tends to economical work. One of the sanitary pumps is so arranged that it can raise hot salt water from the main circulating discharge pipe to the hot salt water bath tanks on the boat deck 70 ft. above. The general service and ballast pumps are each capable of discharging 200 tons per hour; they, together with the fire pump and two fresh water pumps, are all of duplex type.

Her Trial Trip.

There are six boilers, two of which are single-ended and four double-ended, arranged in two compartments, the after boiler room having two double-ended and two single-ended boilers, and the forward room two double-ended boilers. The furnace gases discharge into two funnels rising to a height of 120 ft. above the center fire bar level. The bunkers, to take 1,500 tons of coal, are arranged on each side of the boiler room, with a cross bunker between the two boiler rooms, and an additional or reserve bunker, to take 770 tons, at the forward end of the boiler space. Silent ash hoists of the Galloway type are fitted in two stokeholds, and a See ash ejector in one of the middle stokeholds.

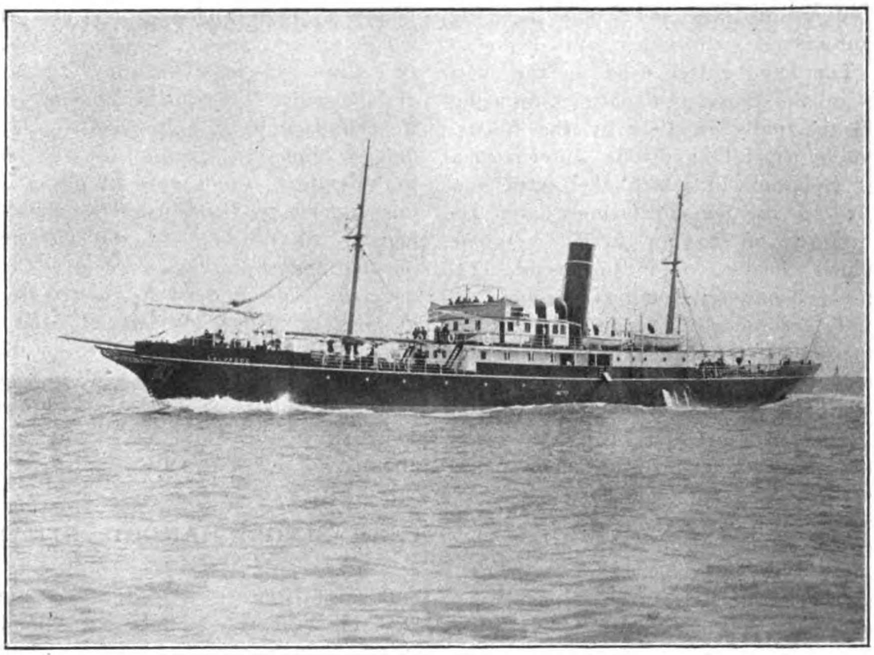
The boilers work at a pressure of 215 lbs., the steam being passed to the main engines without a reducing valve; it is reduced at the electric engines to 180 lbs.; at the refrigerating engines, 150 lbs.; at the main and auxiliary feed pumps, 215 lbs.; at the steering engines and deck winches, 150 lbs.; and at the air and hot well pumps, and other auxiliary engines, 150 lbs.; while to the pantry steam at 50 lbs. pressure is passed, and for heating the ship the steam pressure is 30 lbs.

On her coal-consumption trip of 24 hours' duration at service speed the Otranto steamed at 17 knots, with the engines indicating 9,660 H. P., and at the rate of coal consumption of 1.15-lb. per I. H. P. per hour for all propulsive purposes. The distance steamed was 408 nautical miles for 119 tons of coal.

At full power the Otranto made a mean speed on two runs on the measured mile of 18.95 knots for 14,450 I. H. P., and 93 R. P. M., her displacement being 15,160 tons. These results, highly satisfactory as they are, may be accepted as a fitting instance of the large measure of efficiency attained by all five steamers, which, with other vessels of the line, will, under the new mail service, maintain the high reputation of the management of the Orient line, and further the commercial prosperity of the commonwealth of Australia.

BUILT IN 64 DAYS.

The Salvador, a gracefully modeled passenger and cargo steamer, resembling more a yacht than an ordinary mercantile ship, has recently been completed by Messrs. Swan, Hunter & Wigham Richardson, Ltd., of Wallsend-on-Tyne. A special note of interest about this ship is that she was completely built and engined by the firm in the remarkably short space of time of 64 working days from the time of signing the contract. This is an extraordinary achievement, considering the ship is a first-class passenger vessel. The vessel has been built to inaugurate the new steamship service that is being opened by the Salvador Railway Co. between Salina Crux and Acajutta. This service will facilitate traveling between Central American ports, and more particularly between the ports above named. The voyage will occupy about 36 hours, against the two and sometimes three days' journey heretofore. The Salvador is 225 ft. in length over all, by 33½ ft. beam, and has been constructed to the highest class in Lloyds Register, and has also a Board of Trade passenger



S. S. SALVADOR.

certificate. Accommodation is provided for 20 first-class passengers in deck houses amidships; the upper deck houses are for the use of the captain and for a chart room, and the side houses are set apart for the officers and engineers. With teak decks, electric lights, electric ventilating fans in each state room, etc., everything about the ship is very suitable for the special trade and climate for which she is intended. The cargo to be usually carried will consist of coffee. The propelling machinery consists of triple-expansion engines, supplied with steam by two nautical draft boilers, and on the trial trip which took place on Sept. 29 the vessel attained a speed of 12½ knots. The engines were also built by Messrs. Swan, Hunter & Wigham Richardson, Ltd. The owners were represented on the trial trip by M. J. Kelly, chairman of the Salvador Railway Co. and consul general for the republic of Salvador, and by C. T. Spencer, director of the Salvador Railway Co. It may also be mentioned that when the launch took place, the vessel was christened by Fraulein Curtius, daughter of the lay president of the Consistory Court in Alsace.

DESTRUCTION OF STEAMSHIP ST. CROIX.

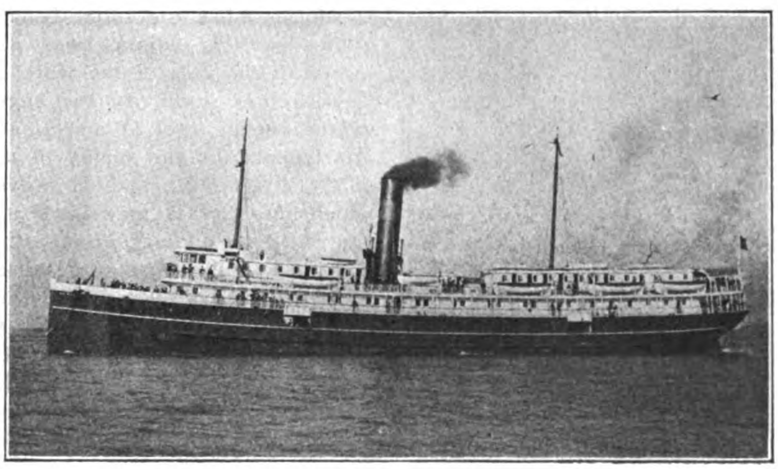
Fire originating in the after cabins totally destroyed the Pacific coast passenger liner St. Croix while at sea Saturday, Nov. 20. The steamer was proceeding at the time from Los Angeles to San Francisco with 100 passengers. The fire was discovered about midday when the steamer was six miles off Point Dume, Cal. Its origin is unknown. The flames made rapid headway and the passengers and crew were forced to abandon the vessel. No one was lost. The wireless apparatus was paralized and unable to render any assistance.

The St. Croix was a wooden steamer built on the Atlantic coast in 1895. She was 240 ft. long, 40 ft. beam, 1,993 gross tons and 1,064 net tons. Last year she was purchased by Schubach & Hamilton Steamship Co., Seattle, and arrived on the Pacific coast in May, 1909. Since that time she has been engaged in the coastwise trade between Seattle and Los Angeles, Cal., via San Francisco. At the time of the accident she was in command of Capt. Frederick Warner. The other officers of the St. Croix are: F. Mills, first officer; J. S. Ford, purser, and W. E. Towne, chief engineer.

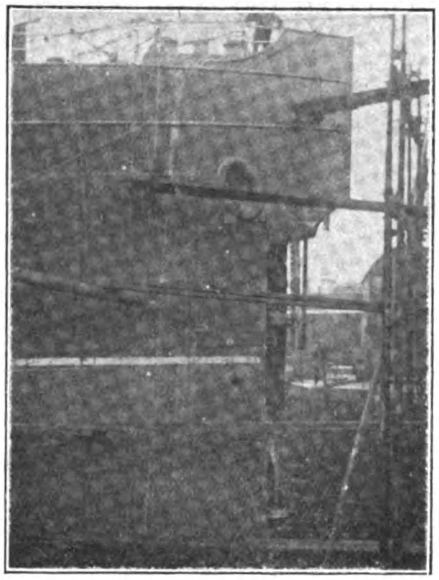
CUTTING OFF A STEAMER'S STEM.

Although demonstrations of cutting metal by means of oxygen have been given in Glasgow by the Scotch & Irish Oxygen Co., Ltd., of Polmardie, the first demonstration of carrying out practical work by this method in the Glasgow district has recently been given, and was attended with marked success. The British Oxygen Co., Ltd., has taken over, and is now developing the business formerly in the hands of the company first named. The success of the British company in work of this kind has been repeatedly shown of late years in London and other districts where it has branches of its business—Birmingham, Manchester and Newcastle. The work just completed in Glasgow was nothing less than the removal of the bow of the steamer Tenasserim, of the fleet of Indian traders, owned and managed by Messrs. P. Henderson & Co., Glasgow. The vessel had been damaged by being in collision, and was put in the hands of Messrs. D. & W. Henderson, of Partick, for repair. The vessel was found to have sustained such serious damage that a large number of plates connected with the stem would have to be removed, and the whole stem rebuilt. Many of the plates, however, were so badly buckled that great difficulty was experienced in driving out the rivets. Messrs. Henderson finally resolved to have the stem and the attached shell-plating bodily cut away by the oxy-acetylene process of metal cutting. The British Oxygen Co. were entrusted with the work. After the erection of proper staging, etc., one operator was put on to the job, and he completed the work in about a day and a half's time.

The illustrations are reproduced from photographs of the stem of the Tenasserim in dock. One shows the cutting effected from near the top of

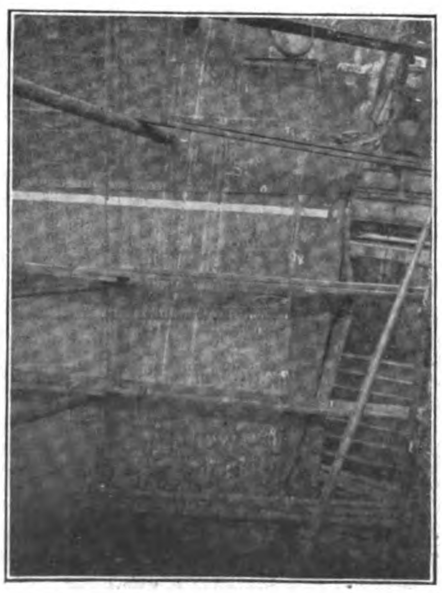


STEAMER ST. CROIX.



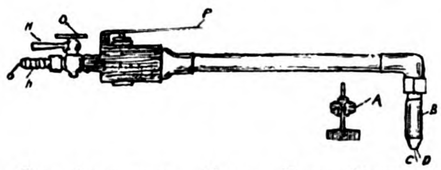
S. S. TENASSERIM.

the stem down to the forefoot, and just prior to the removal of the severed portion by the crane, and the other after this removal had taken place. The total length of cutting was about 90 ft. Single plates were ½ in. thick, and, of course, double thickness was encountered where they overlapped at the landings. The stem bar was broken through at the top, where the cutting commenced, but was intact at the bottom, and the total thickness to be cut through there including the plates on each side of the stem was 5½ in. The workman entrusted with the job by the Oxygen Co. completed the task as has been said in about 1½ days, but had the weather conditions not been so unfavorable, and had he been more accustomed to working on scaffolding, the task could have been accomplished well within one day.



S. S. TENASSERIM.

The hand cutter used on the work is of the blow pipe pattern introduced originally in 1904 by the Societe Anonyme L'Oxhydrique International of Belgium, in which the extra supply of oxygen—following upon the mixture of oxygen and acetylene, which heats to incandescence the metal being acted upon—effecting actual severance, is supplied through one nozzle. Another form of cutting instrument, as is well known has separate nozzles, one projecting the flame of mixed gases, and the other placed immediately behind the flame, projecting the extra and independent oxygen which effects the actual cutting. The heating arrangement in the cutter under notice is on the injector principle, the oxygen alone being supplied under pressure; the fuel gas is drawn into the cylindrical mixing chamber, and it passes along with the oxygen along the tube and out through the nozzle. The two gases enter the apparatus side by side at



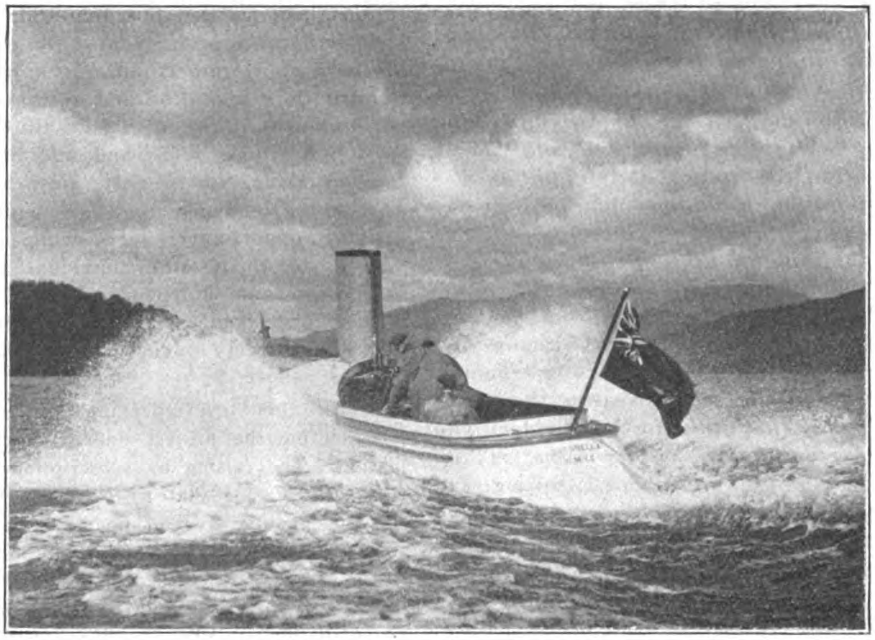
OXY-ACETYLENE BLOW PIPE CUTTER.

the inlets to the left of the chamber, and are separately adjusted by means of two cocks or valves. The two mixed gases discharge through an annular opening in the end of the nozzle. The oxygen which is used for cutting issues through a separate passage in the center of the nozzle, and is controlled by a thumb lever valve on the top of the chamber portion of the apparatus. The adjusted sliding guide shown at the side of the nozzle may be attached thereto to maintain a uniform distance between the cutter and the work, and also to insure steadiness when the cutter is in operation, but this adjunct was not required in the case of the work of the Tenasserim's stem. In the engraving of the cutting tool O and L are the attachments for the supply of oxygen and acetylene; O and H valves by which these gases may be separately controlled; D annular passage through which the mixed gases are discharged; P the thumb lever for regulating the jet of oxygen for cutting; C the passage through which the jet of oxygen for cutting is discharged; and A an adjustable sliding guide which can be attached to the cutter head at B, in order to maintain a uniform distance between the cutter and the work, and to insure steadiness when the cutter is in operation. Oxygen and dissolved acetylene compressed in cylinders were employed, the cylinders lying at the bottom of the graving dock, the supply of gases being carried to the cutter by suitable lengths of tubing. In the carrying out of the work, the Oxygen Co.'s operator was under the instructions of Messrs. D. & W. Henderson & Co., and it is conceded by them that had the work been carried through by the ordinary method of hand cutting, it would have taken 10 men about two days to finish it.

FAST SINGLE-HANDED STEAM LAUNCH.

We are able to reproduce two interesting pictures of a remarkable steam launch which has been built to the order of Leonard Williamson, of Southport, for use on Lake Windermere. That a steamboat with machinery of 140 H. P. could be capable of being entirely handled by a single man would seem, on the face of it, to be impracticable, but this result has been achieved by Messrs. Simpson, Strickland & Co., Ltd., the well-known launch builders of Dartmouth. It is also a matter of satisfaction that she has turned out all that was desired by her owner. She is 38 ft. in length by 6 ft. beam, and 3 ft. 3 in. deep. Built of galvanized steel, and weighing complete, with machinery on board just over 4 tons, the boat is arranged with a large turtle deck forward, extending right aft over the boiler, and covering the fuel tanks; aft of this is the machinery space and then comes a large comfortably fitted well carrying about 10 people.

In order to make the boat capable of being handled by a single man, coal firing was of course out of the question, and a special type of two drum water tube boiler is employed, designed by the builders, fired by means of two large oil burners, built by the Lune Valley Engineering Co., of Lancaster, which have proved very satisfactory in giving complete control and ample supply of steam. The engines consist of the makers' very light four crank quadruple-expansion machinery, giving 140 I. H. P. at 1,100 R. P. M., with 330 lbs. of steam and having cylinders 3⅞ in., 5⅛ in., 7½ in. and 11 in. in diameter by 4½ in. stroke and weighing 9 cwt. Nickel steel enters largely into the construction of the moving parts and piston valves are used



FAST SINGLE HANDED STEAM LAUNCH BUILT BY SIMPSON, STRICKLAND & CO.

throughout. The high pressure and first intermediate valves are driven by one set of valve gear; the second intermediate and low pressure valves being driven by a second set, the two valves respectively being on a common crosshead. Automatic pressure sight-feed lubricators are provided for every part of the engine, controlled by a single cock, and these require no attention while running. The exhaust is carried up the funnel, and owing to the large number of expansions obtained in the engine, is quite silent, while sufficient to create a draft for the burners.

The steering wheel in placed abreast of the engine on the starboard side, and the burner control levers, reversing lever, stop-valve, etc., are all placed within easy reach, so that with the perfect control which the liquid fuel gives for the fire, the boat is easily handled by a single man. She has obtained a speed of 23 miles per hour, and is thus the fastest boat by far on Lake Windermere. When at full speed, as will be seen from the photograph, a good deal of spray is raised, but there is very little wave-making, and unless the wind is on the beam the boat is very dry.

MOSHER BOILERS FOR KEARSARGE AND KENTUCKY.

The Mosher Water Tube Boiler Co., 30 Church St., New York, has been awarded contract for the installation of new boilers in the battleships Kearsarge and Kentucky. Each ship will receive eight boilers with a total heating surface of 31,360 sq. ft. and grate surface of 725 sq. ft.; length of grates, 7 ft.; tubes will be 2 in. outside diameter No. 8 B. W. G. Boilers will carry a working pressure of 180 lb. per sq. in. and are known as the "B" marine type.

STEAMER SENATOR AT FAULT.

Charles M. York and Charles M. Gooding, local inspectors of steamboats at Marquette, have rendered the decision in the collision case between the steamers Senator and Norman B. Ream, finding the Senator at fault. No blame is attached to Capt. A. C. Chapman, master of the Ream. The inspectors have suspended the license of W. K. Nesbitt, master of the Senator, for thirty days. The collision occurred on Aug. 23, 1909, and the Senator was out of commission for three months thereafter undergoing repairs which were very extensive. The decision of the local inspectors in quite interesting. The circumstances surrounding the accident are very clearly told in the decision as follows:

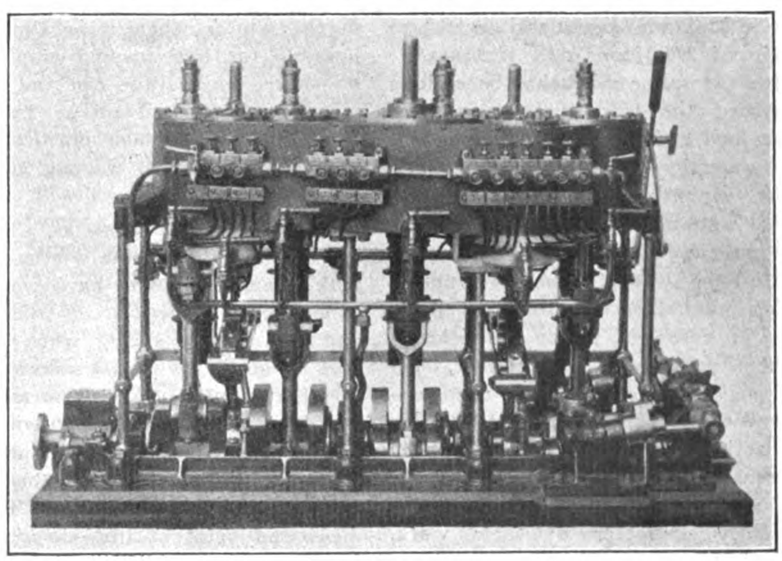
We do not agree with your counsel in construing this case as one of special circumstances and that, therefore, rule X of the pilot rules does not apply.

While it is admitted that in narrow channels, obscured short bends in rivers, crowded harbors, etc., conditions might arise which would render a strict compliance by steamers with the provisions of rule X unsafe and unapproachable, yet we can find no special circumstances in the case under consideration, which, after you had received the danger signal from the Ream in answer to your two-blast signal denying your request to cross her bow; giving you due notice at the required distance that she would or could not agree to such maneuver that authorized you to deviate from the requirements of said rule.

The weather was clear, with no wind that at all affected navigation. You saw and noted the movement of the Ream a long distance away; the signals exchanged between the two steamers were seasonable. The Ream was on your starboard bow and therefore the privileged steamer; the collision, occurring, if anything, to the eastward of the chart course, and about half way between Sweets point and Pipe island, there was sufficient depth of water and ample room if reasonable precautions had been taken by the Senator to have checked, stopped or passed astern of the Ream, and we cannot see what conditions there were at the time which did not admit of the Senator executing either of the above maneuvers.

The Ream being the privileged steamer, it was not required to answer the Senator's two-blast passing signal with a similar whistle, nor was she obliged to conform her navigation to that of the Senator. Although your two-blast whistle signals indicating your wish to navigate otherwise than in accord with rule X, and cross the bow or ahead of the Ream, were responded to by that steamer with danger signals, which was a distinct refusal, in our opinion, to enter into any such agreement, and also a notice of the danger of the undertaking, yet you still persisted in the attempt with the result that the collision occurred and the Senator was sunk. In the absence of an agreement between yourself and Capt. Chapman to depart from the provisions of rule X, upon this first notice, or danger signal, you should have adopted the safe course, and gone astern of the Ream.

When a master and pilot of a steamer without actual necessity adopts a dangerous course, and fails in the purpose he is chargeable with fault, and must bear the responsibility. We are convinced from the evidence in this investigation that if the steamer Senator had navigated in strict compliance with the pilot rules of the Great Lakes this collision would not have occurred.



ENGINE OF SINGLE HANDED STEAM LAUNCH.

Sailors' Institute on the Lakes

A SAILORS' Institute to cost $350,000 is to be established in Cleveland by the leading lake interests including vessel owners, dock operators and coal and ore shippers. Work on the plans has been going on actively for several months and a large part of the money is already subscribed. The committee in charge of the project consists of Samuel Mather, E. W. Oglebay, W. G. Pollock, H. Coulby, D. R. Hanna, Gen. George A. Garretson and J. H. Sheadle.

The institute will be located near the water front, several available sites being now under consideration, and work upon the structure will be actively begun early in spring. There is a possibility also that some time in the future a home for aged and invalid seamen will be established in conjunction with the institute. Lake interests have long had the plan in mind, but financial and other difficulties have prevented an earlier fruition. The general scope of the plan has been outlined in a prospectus issued by its projectors. This prospectus says:

"During the past decade the commerce of the great lakes has increased two and one-half times, and there is every indication that the movement of freight during the season of 1910 will approximate 100,000,000 tons. The United States government has spent millions of dollars in improving and deepening the connecting waterways. New ships have been built, increasing the cargo capacity from 4,000 to 12,000 tons per trip. The same progress has been made in cargo handling facilities, so that today ships of 10,000 tons are unloaded in half the time it took ten years ago to unload a ship of 3,000 tons.

"For the sailor much has been done on board the ships in the way of better food and quarters and it may be said generally in respect of wages, roomy, sanitary quarters and conveniences, with abundance of good food, we are in advance of any other part of the world. The government marine hospital service furnishes treatment in cases of injury or sickness to the point of convalescense, but there is no provision for the convalescent or the superannuated. For the active workers little has been done ashore for men who by tradition and habits growing out of the transitory character of their work, have not opportunities or inducements to the more stable relations and habits of those whose employment and manner of life require and promote fixed residence and habits.

"In the early days of lake navigation the work was done in wooden sailing vessels, whose crews were of the same type as trained anywhere in sailing ships; and during our operating season sailors came from England, Norway, Sweden and Germany and seaport towns of the old country. During the winter season there was plenty of work for the sailor who desired to stay on the lakes, in rigging work, overhauling, caulking and other repairs, which was part of the sailor's education.

"The advent of the steamship and the development of the steel ship, of rapidly increased size, literally transformed all this. Not only the engine force, for the deck officers are required to be licensed after a rigid government examination. Repairs and overhauling of steamships is the business of a separate trade, neither requiring nor imparting any knowledge of navigation.

"The work of lake navigation has become specialized, and the practical training on ship board must be augmented and go hand in hand with study, the reading of books, and knowledge of rules and theory. In every other profession training schools have been provided ashore available for young men. Nothing has been done systematically along this line for the young man who desires to follow the water for a livelihood. During the winter season there is little work for the crew, except laying up of the ship in the fall and fitting her out in the spring, leaving the sailor with three to four months of idle time in the winter when it is almost impossible for him to find employment on shore, which time can and will be utilized to full advantage by many young men with suitable practical opportunity for study and training at a reasonable cost.

"Such principal ports as Cleveland are crowded during the winter months with young men who have worked in subordinate capacities on the ships; and also in the spring when navigation is about to open, sailors gather in large numbers like all members of the human family they gravitate together and mingle with their own people, and dissociated by the radical difference in character of employment and habit of life, they are not found in the public librabries, reading and social rooms and such institutions, or in the boarding houses and similar places frequented by people with shore opportunities and habits; but their invitation and ever present opportunity is to the traditional sailors' boarding house and saloon of the waterside, where they must and do congregate under conditions which, denying opportunity, even choke incentive to thrift and individual development and independence in obtaining the comforts and essentials of life, so freely open in fixed occupations ashore.

"With this brief preface we will now outline the project under contemplation. The raising by subscription of the sum of $350,000 to be used for the purchasing of land necessary and for the construction and equipment of a sailors' institute, to be located in the city of Cleveland, in which will be provided reading rooms, writing rooms, some kind of recreation, such as bowling, billiards and pool tables, adequate bathing and sanitary accommodations and an assembly room in which meetings can be held and classes of instruction arranged during the winter months. Also to have an arrangement with some responsible bank to open a branch in the institute, to encourage men to save their money and facilitate, during the shipping season, the transmission of their savings to their families.

"During the closed season it is proposed to arrange for lectures in practical engineering and navigation, so as to give the young fellows every opportunity of advancement in their calling. A number of sleeping rooms to be provided, similar to those in the Mills hotels in New York, to be placed at the disposal of the men at a reasonable cost. No intoxicating liquors to be allowed on the premises, and a man's affiliation or non-affiliation with any religious, trade or other organization not in itself to constitute a bar to admission. A charge to be made for sleeping rooms and meals, but the institution not to be run for profit, but if any surplus revenue or funds accrue, these to be used for the purposes of the institute, or if the trustees deem wise, in the acquirement or maintenance of a home for aged and invalid officers and seamen."

Capt. Perry Denner died at his home at Chippewa Bay near Ogdensburg, N. Y., on Dec. 3. He had sailed the great lakes for many years, beginning fifty-seven years ago in sailing craft. He was over eighty years of age.

CLOSE OF LAKE SEASON.

The lake season of 1909 may be at an end though some vessels are still out and one or two are yet to sail. The steamer Charles Hebard, of the Wilson Transit Co.'s fleet, has been chartered to carry wheat from Fort William to Buffalo at 4 cents. She will leave without insurance on Friday with 330,000 bushels and her freight will yield her something more than $13,000. The steamer Capt. Thomas Wilson will load coal at Buffalo either on Friday or Saturday for Milwaukee at $1 per ton. These are the highest rates paid this season. The last ore cargo of the season was carried from Escanaba on Wednesday by the steamer Mariposa.

Notwithstanding numerous delays, such as the strike of the switchmen, the crippling of the Poe lock, frozen ore and vicissitudes of weather, the fleet succeeded in moving nearly 5,000,000 tons during November, the exact figures being 4,899,220 tons. This makes the total movement to Dec. 1, 41,164,359 tons which is only 124,396 tons less than was moved during the full season of 1907. The record, therefore, for 1907 has been broken as about 350,000 tons will be moved during December. This is a most extraordinary performance as the present season opened quite late. Following are the figures tabulated for the month of November and up to Dec. 1 with comparative data for the two preceding years:

Port.	Nov., 1907.	Nov., 1908.	Nov., 1909.
Escanaba	469,373	586,112	701,646
Marquette	307,547	290,451	369,478
Ashland	319,438	479,015	600,469
Superior	679,237	629,771	758,073
Duluth	1,537,438	876,600	1,446,288
Two Harbors....	843,043	756,146	1,023,266
	4,156,076	3,618,095	4,899,220

Port.	To Dec. 1, 1907.	To Dec. 1, 1908.	To Dec. 1, 1909.
Escanaba	5,722,416	3,332,229	5,632,421
Marquette	3,009 360	1,468,181	2,877,191
Ashland	3,423,277	2,498,963	3,736,744
Superior	7,427,182	3,538,390	6,505,527
Duluth	13,445,977	8,808 168	13,296,326
Two Harbors..	8,169,727	5,702,237	9,116,150
	41,197,939	25,348,168	41,164,359

Regarding ore prices for 1910, everyone is keeping quite still and there seems to be no disposition to make a move until after the holidays.

Accidents during the week have been quite numerous and costly, the most serious being the sinking of the steamer Henry Steinbrenner in Mud Lake in collision with the steamer H. A. Berwind during a blinding snow storm. The Steinbrenner was given a terrific blow on the starboard side and sank almost immediately. She has now sunk into mud about six feet and as the mud has freely mingled with her cargo of ore, the job of raising her will be a difficult one.

The Berwind stood alongside the Steinbrenner until morning when she proceeded to Detour. As owing to her own injuries she was drawing too much water to go up the old channel to the Sault, permission was given her to go up the new channel and she was taken to the Sault for temporary repairs. The Steinbrenner is owned by Henry Steinbrenner of Cleveland and the Berwind by G. A. Tomlinson of Duluth. The Steinbrenner was later abandoned to the underwriters by the owners as a total loss.

The steamer B. Lyman Smith of the United States Transportation Co.'s fleet, bound from the Canadian head of the lakes to Buffalo, went ashore just outside of Port Arthur. She also will have to lighter.

The steamer Uganda is fast on Grassy island, Detroit river, and may have to be dredged off. She was bound down without cargo and was caught in the heavy blow of Sunday, Dec. 5.

The steamer Sir Thomas Shaughnessy is at the Superior shipyard with twenty-two broken plates, as a result of striking at Blake's Point while entering the Passage Island channel near Isle Royal.

The steamer James H. Hoyt which went on the rocks on Outer island, Lake Superior, on Nov. 13 was released after two weeks of effort by Capt. James Reid, the wrecker. The Hoyt had been abandoned by her owners to the underwriters.

The steamers Frank C. Ball and Hoover and Mason were in collision in Lake St. Clair. The Ball received about a dozen damaged plates and was taken to Toledo for repairs. The Hoover and Mason proceeded to Duluth with her cargo of coal and then went into dry dock for a survey.

The steamer Charles Weston, which was in collision with the steamer Ward Ames above the Sault, was taken to Lorain for repairs.

The steamer Bransford, which went ashore near Menagerie island light, Lake Superior, was released on the fifth day by the wrecker Favorite. As she was short of fuel the Favorite towed her to the Sault.

The bulk freighter W. C. Richardson foundered within one mile of Buffalo today, drowning five members of her crew. The accident was caused by the shifting of her cargo of flax. The Richardson was owned by W. C. Richardson & Co., of Cleveland, and was built in 1902. She was 354 feet keel and 48 feet beam.

The package freighter Clarion, of the Anchor Line, caught fire near Southeast Shoal and will probably be a total loss. Twelve members of her crew are missing though it is not as yet known whether they reached shore or not.

CONTRACTS FOR LAKE VESSELS.

Charles B. Calder, general manager of the Toledo Ship Building Co., Toledo, has closed contract with the Argo Steamship Co. of Cleveland for a steel lumber carrier to be 256 ft. over all, 236 ft. keel, 40 ft. beam and 17 ft. deep, equipped with triple-expansion engines and Scotch boilers.

Contract has also been awarded to the Toledo Ship Building Co. for the new excursion steamer for the Detroit, Belle Isle & Windsor Ferry Co. This new steamer will be 196 ft. over all, 181 ft. between perpendiculars and 62 ft. beam over guards. She is promised for delivery next June.

This makes twenty-seven vessels under contract for 1910 delivery, fourteen of which are building by the American Ship Building Co., eight by the Great Lakes Engineering Works, four by the Toledo Ship Building Co. and one by the Manitowoc Dry Dock Co.

The three steamers building at the Ecorse yard of the Great Lakes Engineering Works for the Pittsburg Steamship Co. will be named in honor of officials of the United States Steel Corporation. The first of the freighters to be launched will be named in honor of William B. Dickson, first vice-president of the Steel Corporation, the second for William J. Olcott, president of the Oliver Iron Mining Co., and the third for William P. Palmer, president of the American Steel & Wire Co.

The bulk freighter A. A. Augustus, building at the Lorain yard of the American Ship Building Co. for the Pioneer Steamship Co. of Cleveland of which Capt. Charles L. Hutchinson is manager, will be launched on Dec 11.

The steamer John P. Morgan Jr. building for the Pittsburg Steamship Co. was launched from the Lorain yard of the American Ship Building Co. on Nov. 13 and was christened by Laura Watterson, the little daughter of Capt. W. W. Watterson, hull superintendent of the Pittsburg Steamship Co. The Morgan is one of the 600-footers.

The new steamer building for the Anchor Line at the Wyandotte yard of the American Ship Building Co. will be launched on Saturday, Dec. 11.

MONUMENT ON BOIS BLANC.

The Detroit, Belle Isle & Windsor Ferry Co. has erected a monument on Bois Blanc Island from designs made by Walter E. Campbell, president of the company. The monument is located on the Amherstburg side of the island in plain sight of passing steamers. It is composed of concrete,

SAILOR'S MONUMENT ON BOIS BLANC ISLAND.

stone and iron and has an elevation of about 35 ft. At the base there is a fender wale and guard iron reproduced in concrete. Six feet above this is the main rail and 12 in. above the main rail is the monkey rail. On the side towards the river is an iron hawse pipe out of which the big chain leads to the large anchor on top. On each side of the hawse pipe and also on the ends of the base are full sized iron chocks molded into the concrete. On the shore side is a modern patent anchor drawn up into position, as it would be in the bow of a steamer. An iron chock is placed on each side of this anchor. The large anchor surmounting the whole is a relic of the past. It is 10 ft. from fluke to fluke with 16 ft. of stock and shank.

NOVEMBER LAKE LEVELS.

The United States Lake Survey reports the stages of the Great Lakes for the month of November, 1909, as follows:—

Lakes.	Feet above tide-water New York.
Superior	602.25
Michigan-Huron	580.13
Erie	571.60
Ontario	245.35

Lake Superior is 0.06 foot lower than last month, 0.02 foot higher than a year ago, 0.73 foot below the average stage of November, of the last 10 years, 1.26 foot below the high stage of November, 1909, and 0.59 foot above the low stage of November, 1892. It will probably fall about 0.3 foot in December.

Lakes Michigan and Huron are 0.25 foot lower than last month, 0.23 foot lower than a year ago, 0.41 foot below the average stage of November of the last ten years, 2.67 feet below the high stage of November, 1885, and 0.95 foot above the low stage of November, 1895. They will probably fall about 0.2 foot in December.

Lake Erie is 0.19 foot lower than last month, 0.11 foot lower than a year ago, 0.24 foot below the average stage of November of the last ten years, 1.98 feet below the high stage of November, 1885, and 0.90 foot above the low stage of November, 1895. It will probably fall about 0.1 foot in December.

Lake Ontario is 0.49 foot lower than last month, 0.57 foot lower than a year ago, 0.04 foot below the average stage of November of the last ten years, 1.34 feet below the high stage of November, 1883, and 1.94 foot above the low stage of November, 1895. It will probably fall about 0.1 foot in December.

FACTS ABOUT A WATERWAY.

A publication that reflects credit upon all connected with it is the report of the Georgian Bay ship canal survey, which has recently been issued in its entirety. The survey itself has been described by contemporary engineers as perhaps the most complete of any ever made of so extensive a project. The report in its printed form is in keeping with the excellence of the engineering feat of which it forms the record. Some idea of its completeness may be formed from the fact that besides the report proper, which consists of over 600 pages of admiralty compiled letter press, there are separately bound, 56 plates covering every detail of the survey, and a volume of 24 half tone reproductions of photographic views, illustrating the various points of scientific and scenic interest along the route.

The main features of the survey, including the recommendations and technical testimony of the engineers, have been dealt with in the press from time to time. But the following data, synopsized from the report of the chief engineer, are worth remembering:

A 22-ft. waterway from Montreal to Georgian Bay will cost $100,000,000.

It can be built in ten years.

Its length would be 440 miles, of which 346 miles are of navigable river and lake.

There are only 28 miles of canal to be excavated and 66 miles of channel to be dredged.

Its construction with a storage system, as planned, would render available a reliable water power supply of 1,000,000 horsepower.

It would save a day and a half in the voyage from the head of lake navigation to Montreal, as compared with the existing St. Lawrence route.

From Fort William to Liverpool, via the Georgian Bay canal route, the distance is 4,123, which is 282 miles shorter than by the present Canadian route, and 806 miles shorter than via the American water route.

The canal would be open to navigation 211 days in the year.

Practically slack water navigation will obtain throughout the entire route.

The rise from Montreal harbor to the summit, 659 ft., can be overcome by 23 locks, ranging from 5 ft. to 50 ft. in lift; the descent of 98 ft. from the summit to Georgian Bay can be made by four locks of from 21 to 29 ft. lift—27 locks in all, connecting 23 navigable pool levels.

The waterway would be entirely in Canadian territory, far removed from the boundary and independent of international waters.

TRADE NOTES.

P. Delany & Co., marine boiler manufacturers of Newburgh, N. Y., have recently closed contract for two large Scotch marine boilers, to be installed in a new ferryboat for the Ramsdell estate. This ferryboat is run between Newburgh and Fishkill-on-the-Hudson, N. Y.

During November the Welin Davit and Lane & DeGroot Co., 17 Battery place, New York, booked orders for 48 lifeboats, the majority of them being 24 ft. in length and upwards, and also for a number of rafts, life preservers, launches and power dories. The company also recently booked several orders for equipment of Welin quadrant davits, including the new auxiliary steam yacht Aloha, building for Commodore Arthur Curtis James, of the New York Yacht Club, at the yard of the Fore River Ship Building Co.; the passenger steamer Alabama, building for the Goodrich line at the Manitowoc Dry Dock Co.'s yard; the passenger and freight steamer building for the American-Hawaiian Steamship Co. at the American Steel Co.'s yard, and the ocean-going tug building for the Lackawanna railway at the Staten Island Ship Building Co.'s yard.

THE HUTCHISON MARINE TACHOMETER.

The maximum of efficiency in the maneuvering of any vehicle is best accomplished by placing the entire control in the hands of one man. The automobile is an excellent example. One man handles everything—steers, controls the engine, arranges the proper ratio of gearing, and operates the brakes. If these duties were divided between two persons, not a fraction of the efficiency of control of the unit machine would result; in fact, the congestion of traffic and speed at which the automobile travels would make such an arrangement an exceedingly dangerous combination. Yet, that many of those driving automobiles could not qualify as a second class helmsman is not to be denied.

The expertness with which one man will handle a launch, compared with that which is possible with the functions divided between pilot and engineer, also demonstrates this fact.

Instantaneous Comprehension As Good As Unit Control.

Unfortunately such an arrangement is impracticable on a large steamship. The complication and unreliability of the mechanism which would be necessary to accomplish this, far overshadows the liability to accident obtaining at present. However, there is no doubt that the bridge and engine room should be brought into closer relation to each other. When a signal is given, the captain should be able to determine immediately as to whether it has been correctly executed. Fewer accidents would result. Man is not infallible; mistakes in transmitting the order to the engine room and in the interpretation and execution of orders are apt to occur, and do occur.

The entire absence of tugs to assist in the docking of the steamers of the great lakes is the first thing that attracts the attention of the salt water navigator. The absence of tidal currents doubtless removes one of the difficulties which at times confront the master of the ocean steamship, but nevertheless, extreme accuracy of control and perfect co-relation between bridge and engine room are necessary for highest efficiency in handling. An indicator showing in pilot house or on bridge, and in the engine room, the exact speed of the engines assists in accomplishing this.

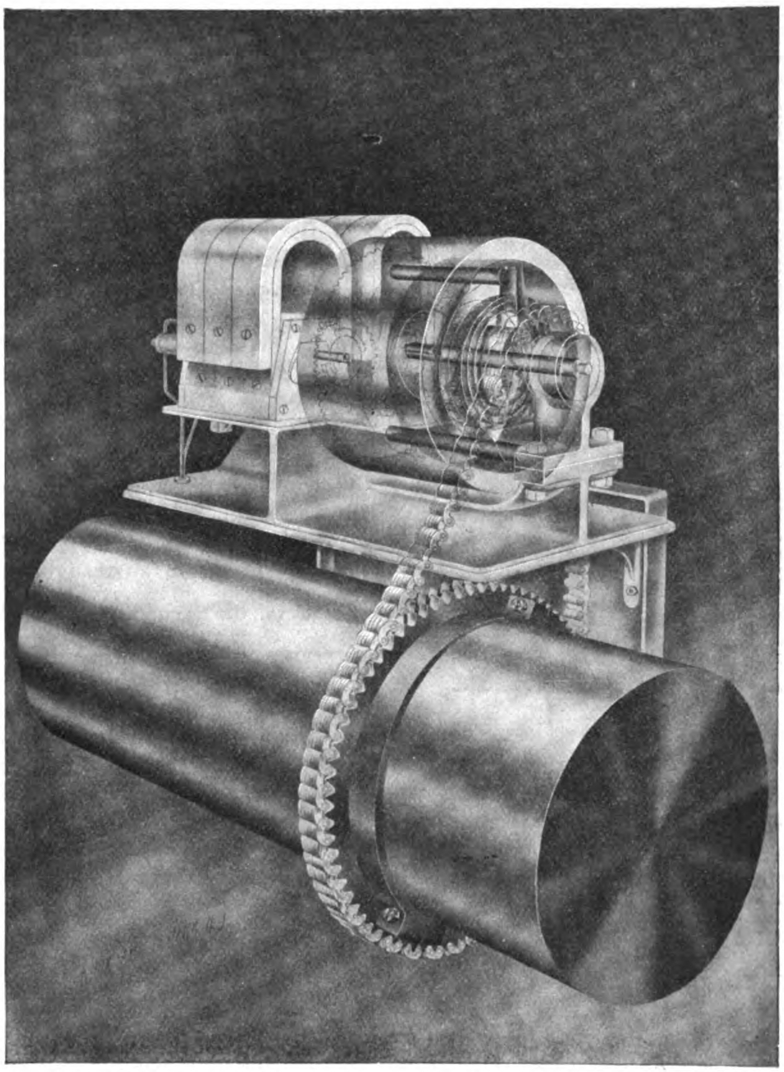


FIG. 1.

Signals Call For Definite Engine Speeds.

Increased efficiency of control is also brought about by a standard speed of propeller rotation for each signal. No two engineers respond to signals alike; whereas, with a dependable and accurate tachometer to guide, and a definite pre-arranged rate of revolution ahead or astern understood, the man at the throttle has but to watch the indicator of the tachometer to produce definite results.

A marine engineer, accustomed to the reciprocating engine, finds it confusing to operate turbines, with no rotating parts visible. An accident which would have proven serious was narrowly averted by quick work with the helm recently, owing to the engineer on watch in the starboard engine room of a twin screw turbine steamer executing a signal for "full speed astern" with "half speed ahead." He opened the wrong valve, and being unable to "see anything turning over" as he expressed it, was unaware of his mistake. The captain was likewise unaware of the error until he found the vessel was not swinging to starboard. It was then too late to depend on assistance from the screw and the helm was put hard over just in time.

By means of the Hutchison marine tachometer it is claimed that two or more turbines or reciprocating engines can be operated at the proper relative speeds to minimize vibration without the necessity of counting revolutions or resorting to the hit and miss basis now obtaining.

Such an installation is also a coal saver. Every steamer has its most efficient cruising speed just as every steam plant has its most efficient load factor. When the revolutions corresponding to this speed have been ascertained, if the engineer on watch has an accurate and dependable tachometer to guide him, he can keep the engines at this point. The result will be economy in coal consumption.

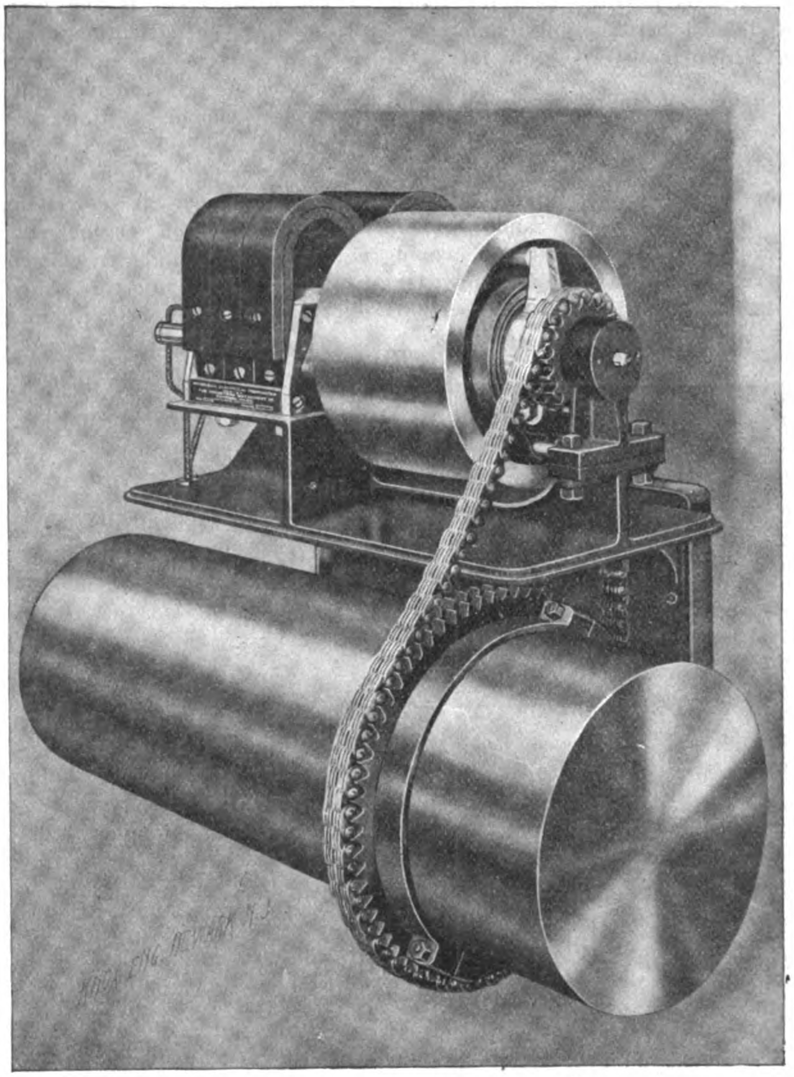


FIG. 2.

The speed in miles per hour being made by the vessel is always the source of a great deal of interest to passengers and transportation lines catering to the passenger traffic can attach a tachometer indicator calibrated in knots or miles per hour, to the same generating outfit employed in connection with the revolution indicators, thereby making the equipment complete.

The current necessary to operate these indicators and provided by the generating unit is so very infinitesimal that it is claimed that the breaking of a wire surrounded by inflammable material will not cause combustion and that the wires may also be short circuited indefinitely without producing any heat or injuring the magnetos in any way. The wires connecting the generating unit with the indicators are, in addition, run through approved armored conduit and are thereby protected from all mechanical injury.

Tachometers are not new, but the designers of the Hutchison marine tachometer claim for it that it is the first perfectly reliable and satisfactory instrument of the kind yet produced commercially.

Why Centrifugal Tachometers Have Failed in This Service.

It is claimed that centrifugal tachometers fail to meet marine requirements because of the impracticability of transmitting the rotation to the bridge or pilot house continuously without failure of shafting, etc., and that furthermore, such an instrument, kept in constant use, will eventually change calibration because of fatigue of the spring control. It is further claimed for the Hutchison tachometer that it maintains its calibration absolutely and is not susceptible to damage other than from physical abuse.

The Pointer of the Hutchison Marine Tachometer Is Steady.

Most tachometers are affected by the variation in angular velocity of the propeller shaft of a reciprocating engine, causing the pointer to swing rapidly between a maximum and minimum value which renders accurate reading difficult. The Hutchison avoids this by an arrangement of flat spiral springs which smooth out the effect of these variations of angular velocity and cause the shaft which actuates the generators to rotate at a constant speed resulting in a steady pointer.

Some of the Troubles of Electrical Tachometers.

Efforts have been made to provide an electrical tachometer which would give simultaneous readings of engine speed at engine room and bridge. A direct current magneto was geared to the propeller shaft, and direct current voltmeters connected to it. These meters were calibrated to show en-

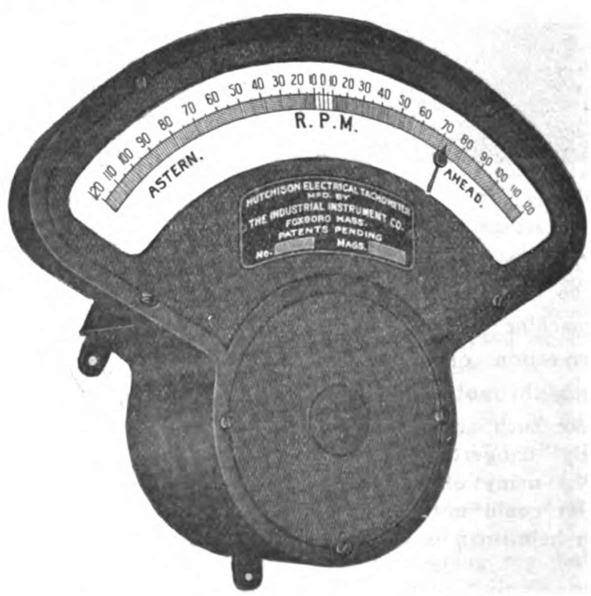


FIG. 3.

gine speed ahead and astern. It is said that while at first working satisfactorily except as affected by angular variation, difficulties due to moving contacts introduced irregularities into the circuit resistance which caused errors in the reading of the meters.

It is claimed that the reason the direct current machine and voltmeters were used was the impossibility of utilizing the magneto in its true form —an alternator without contacts—because an alternating current voltmeter reads but one way, regardless of the polarity of the circuit and that therefore deflections to both sides of a central zero to show speeds ahead and astern, were impossible of attainment in the then existing state of the art.

History of the Hutchison Marine Tachometer.

Several years ago, Miller Reese Hutchison of New York, an electrical engineer, turned his attention to producing a dependable tachometer because of the very evident market for such a device. Assurances from naval officers confirmed his opinion. The problem was attacked from an entirely new standpoint. As a result, the tachometer installed on one of the United States cruisers in June, 1908, continues in satisfactory service without any attention whatever other than occasional oiling.

The secret of success appears to be in the abandonment of magnetos with revolving armatures and commutators, with consequent impossibility of keeping clean contacts, and the adoption of a special inductor type magneto, with stationary armature and poles, hence leading the current from the armature without contacts. The magneto is, furthermore, of such design as insures absolute permanence of magnetism.

The Generating Unit.

Clamped around the propeller shaft is a split sprocket (Figs. 1 and 2). Rotation is imparted to the driven sprocket by Morse silent chain. The driven sprocket is not keyed to shaft, but is rotatably mounted thereon. Two oppositely coiled flat spiral springs transmit the rotation to the flywheel and shaft, one end of each spring being attached to the driven sprocket and the other end of each to the flywheel. Hence any irregularity of rotation caused by variations in the angular velocity of the main shaft, is smoothed out by the springs, imparting to the flywheel and shaft a constant resultant speed. The springs are protected against breakage from sudden reversal of the propeller shaft by a radial arm which engages a pin attached to flywheel when reversal takes place.

On the inside of flywheel at the end opposite to that occupied by the flat springs gear teeth are cut. These engage two pinions which actuate magnetos.

One pinion is keyed to inductor shaft of one magneto, the other is so mounted that when the direction of rotation of the main shaft is *"ahead"* the inductor of the second magneto is exactly in the same rotative relation to its armature and pole shoes as that of the first magneto. The current from the second magneto is therefore in absolute phase with that from the first. But when the main shaft is reversed in rotation, the second pinion rotates idly on the shaft of its magneto through 90 degrees before beginning to rotate same. This causes the inductor of the second magneto to assume an exactly opposite relation to its armature and pole pieces to that obtaining at the instant in the first and hence the current from one is 180 degrees electrically out of phase with the other.

FIG. 4.

There are therefore, two wires from each running to the indicators. At *"ahead"* these circuits are in phase and when the main shaft is reversed or *astern* one is 180 degrees out of phase with the other.

The Indicators.

The indicators, Figs. 3 and 4, are especially designed to withstand continued vibration. They are waterproof and rust proof, and not affected by the rolling or pitching of the ship.

Fig. 3 shows the engine room type, having large scale and prominent pointer. It may be read from a distance of 20 to 30 ft., and when placed in line of vision with the man at the throttle, enables him to bring his engine to any desired speed, quickly and accurately.

Fig. 4 illustrates the pilot house type of indicator. It has no iron, steel or other compass deflecting metal in its construction, and may be placed in proximity to the compass without affecting it. The current used in this system is alternating and of exceedingly small quantity. Therefore, no compass trouble from this source is possible. In fact every possible contingency seems to have been guarded against.

This same indicator is used as a chart room and stateroom type as in the pilot house, excepting that an iron case is used instead of brass. By installing one of these indicators in the staterooms of the captain and chief engineer, both may be kept in close touch with the engine performance at all times.

Fig. 5 shows the bridge binnacle type, supporting, in the case of a twin screw equipment, two indicators —one for each shaft, properly marked. The construction is of brass throughout and it can be placed alongside the compass binnacle with impunity. The scale is placed at an angle so as to be easily read when standing. The entire fixture is waterproof, and of strong construction. Illumination of the scales is provided by an oil lamp or electric light attachment similar to the compass binnacle when desired. Each of these instruments has two coils—a moving coil, to which the pointer is attached, and a fixed or field coil. The moving coil is connected electrically to one of the magnetos, the fixed coil to the other. When the two magnetos are in phase, the pointer is deflected to the right, indicating speed *ahead*. When they are out of phase, the pointer is deflected to the left, indicating speed astern. The more rapidly the shaft revolves in either direction, the higher the voltage generated, and the greater the deflection of the pointer calibrated to conform thereto.

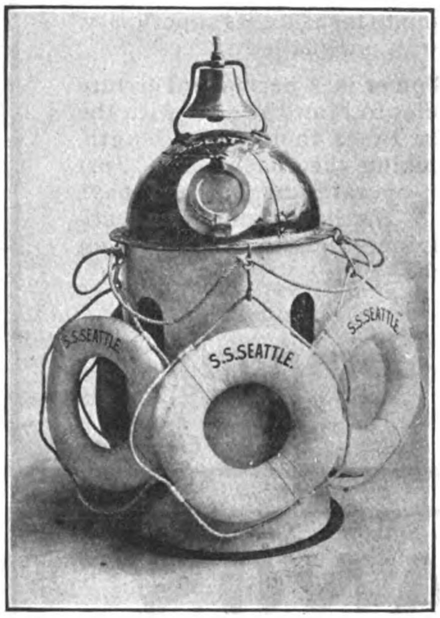
It all appears extremely simple, in fact, it could scarcely be more so. Without any contacts, complications or switches and no parts subject to damage other than from unusual physical abuse, it is claimed to be a perfectly dependable and steady tachometer which should commend itself to those interested.

The makers, The Industrial Instrument Co., Foxboro, Mass., say that each outfit is assembled and calibrated before shipping for installation. The conditions under which it must

operate must be known, as each plant differs in minor detail, and all particulars may be had by addressing the company.

LIFE SAVING AND WRECK LOCATING DEVICE.

An interesting life saving and wreck locating gear, which we illustrate herewith, has been invented by Frank P. Brust, Seattle Wash. The object of the device is three fold: to mark the position of a foundered vessel, to assist in saving the lives of the passengers and crew and to provide a safe receptacle for important papers and small articles of value. The device will find its most satisfactory application to vessels plying inland waters.



WRECK LOCATING AND LIFE SAVING BUOY.

The invention consists of a buoy which is held in a cylindrical framework bolted securely to the steamer's deck. In the lower part of the framework is mounted a reel carrying a light, flexible metallic cable one end of which is fastened to the buoy. When a vessel equipped with this gear sinks, the buoy floats on the surface, the cable unwinding as the ship settles. When the ship finally finds a resting place on the bottom, the buoy, being moored to the wreck, locates its position. Twelve life preservers as shown in the illustration are fastened around the buoy. They are easily detachable and may be used to rescue passengers or crew. A bell mounted on the buoy attracts attention to its position. Inside the bouy is a compartment, reached through a watertight hand-hole, which can be used for stowing important papers, light articles of value, rations and stimulants.

The standard size of the bouy designed by Mr. Brust has a diameter of 3 ft. and a displacement of 900 lb.

The reel is so protected that there is no danger of the line fouling in unwinding.

The device has been subjected to satisfactory tests and performs its functions efficiently.

Within reasonable limits, any length of line desired may be used in connection with the bouy. For vessels plying ordinary inland waters this length would not be excessive.

THE ST. LAWRENCE RIVER ROUTE.

Capt. Alex. McDougall, of Duluth, Minn., wrote one of the members of the Shipping Federation of Canada recently, as follows:—

"I have just arrived home from a trip to Liverpool, and then a trip up the great lakes and their connecting rivers, and I made a careful study of the trip to Montreal, and a comparative examination of the route through to Duluth, for the latter part of which I have a pilot's license. I had often read and heard of the St. Lawrence route being so dangerous or difficult to navigate as compared to the route from New York, which to some extent is so, for the New York route is exceptionally favorable the year round. In the navigation of the gulf for its season, I could not see the reasons for so much dread of it, much of which I think will disappear as the shipping increases and the aids to navigation improve, and more men get better acquainted with the objectionable features in its navigation.

"I had been on the lower St. Lawrence before, and with some experience in dispatching ships in and out of the Gulf, so, while on the steamship Megantic on her first voyage as passenger to Montreal, I heard her officers say that she was the largest ship (565 ft.) that could navigate the St. Lawrence, and that a 600-footer would be too long for the narrow, crooked channels to Montreal. I asked the captain to grant me the privilege to examine the charts, and to allow me in a prominent place in the ship to best see the channel.

"I looked into the matter very carefully, and when I got to Montreal I was of the opinion that there was a channel that a ship 1,000 ft. long could navigate much better than our numerous 600-footers of the upper lakes can navigate the Detroit and St. Mary's rivers, which in their whole length require about 1,200 buoys, beacons and aids to navigation, to show or tell how to enter and pass the intricate channels and bends of the route. From Buffalo to Duluth, 1,000 miles, where steamships of more than 600 ft. are more numerous than are the different kinds of craft on the St. Lawrence, they run and pass each other night and day in the present channels of our rivers and bays, sometimes drawing 19 or 20 ft., and only 2 to 3 in. to spare over the rocky bottom of the channel.

"Many of those 600-footers make from 20 to 25 round trips from May 1 to Dec. 10, and the captains and mates are the only pilots and also attend to all the other duties belonging to the ship's officers, and I think they could navigate ships 1,000 ft. long in our channels of the rivers that connect our lakes and bays, and which are not nearly so good as the channel from Montreal to the sea, and our fog, snow and thick weather is as bad or worse than on the St. Lawrence outlet. I think that if a committee of your harbor commission and pilots would make a trip of investigation and look over the route from Buffalo to Port Arthur or to Duluth, and see our channels night and day in the latter part of the season, when the traffic is greatest, and nights the longest and darkest, they would learn some points of interest to themselves, and of great value to Montreal.

"I think the Canadian government has been doing splendid work improving the lower St. Lawrence, which work will be moderately permanent, for the St. Lawrence has but little or no sediment. If I were a citizen of Montreal I would endeavor to stop the general shipping gossip that the channel is not good enough for larger ships, and I would urge the government to still improve the good work it had been doing.

"About a month ago I was on the bridge with the pilot going up and down the river Scheldt to Antwerp, where not long ago a great deal of talk in shipping circles against that channel was hurtful to the port. But of late, I am told, as they improve the channel the shipping is increasing, and there is a much better sentiment for the port, as I hope you will soon have for Montreal, for I think you will be the outlet for an enormous tonnage in the future."

Archibald Payton, for many years assistant superintendent of the Lorain plant of the American Ship Building Co., has been appointed acting superintendent until further notice. Superintendent F. C. LaMarche has been ill for some time and has been unable to attend to his duties.

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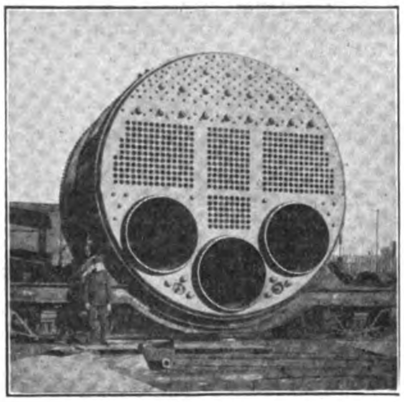

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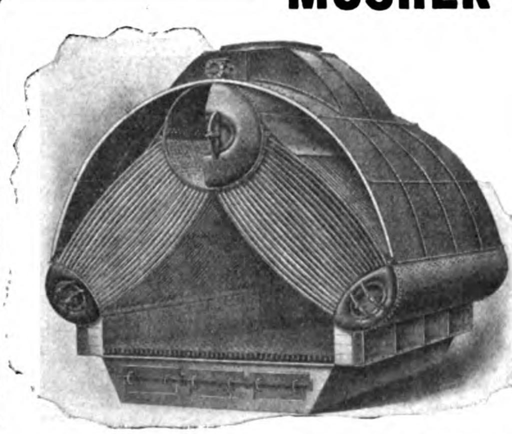

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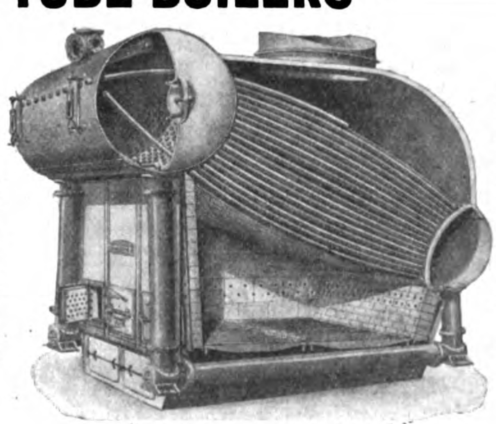

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Truscott Boat Mfg. Co., St. Joseph, Mich.

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Atlantic Works, East Boston, Mass.
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Chicago Ship Building Co., Chicago, Ill.
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Superior Ship Building Co., Superior, Wis.
Taylor Water Tube Boiler Co., Detroit, Mich.
Toledo Ship Building Co., Toledo, O.

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Pittsburg Forge & Iron Co., Pittsburg, Pa.

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Penton Publishing Co., The, Cleveland, O.

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Penberthy Injector Co., Detroit, Mich.

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Scherzer Rolling Lift Bridge Co., Chicago, Ill.

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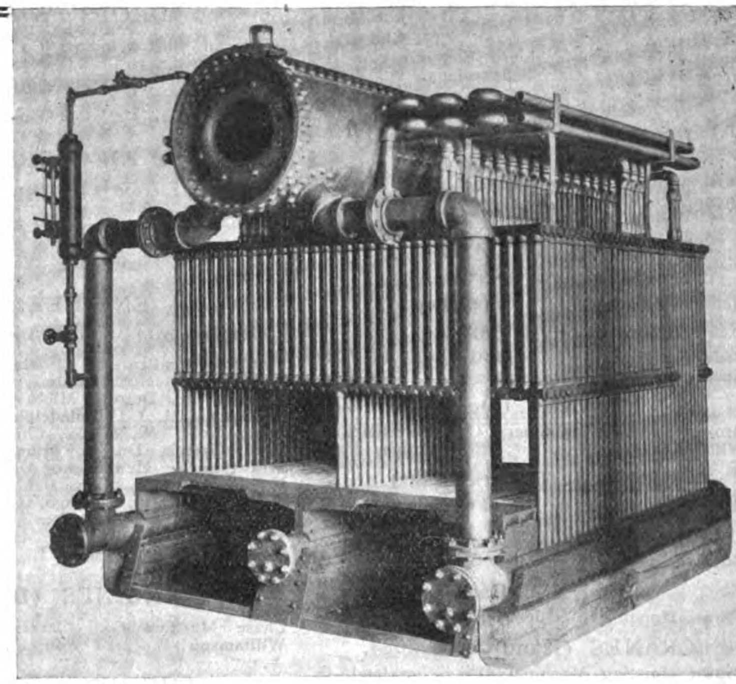

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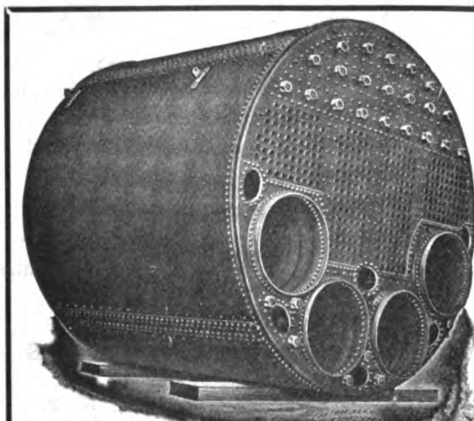

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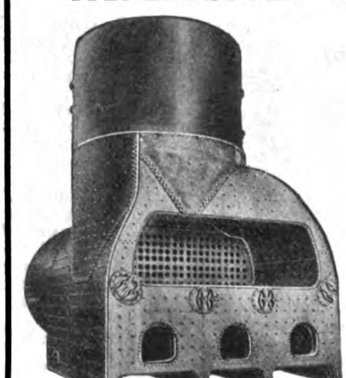

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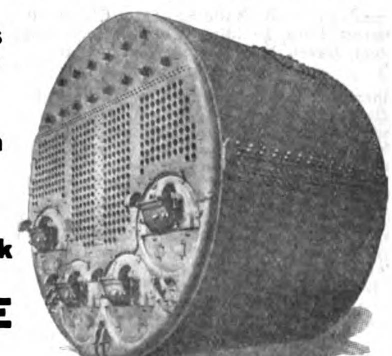

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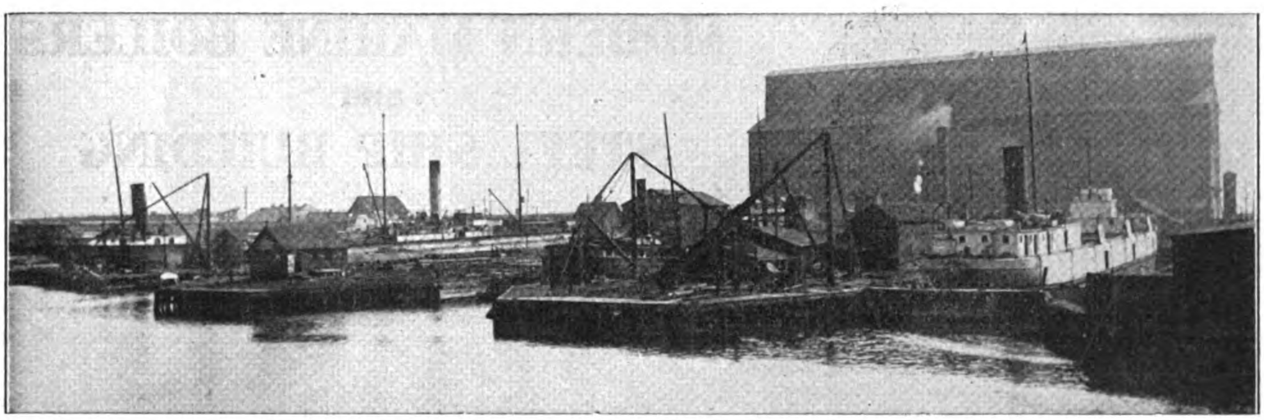

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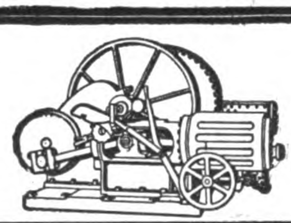

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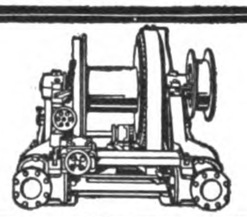

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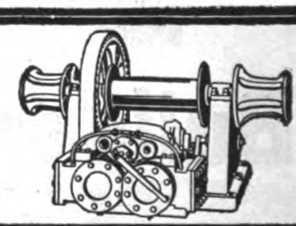

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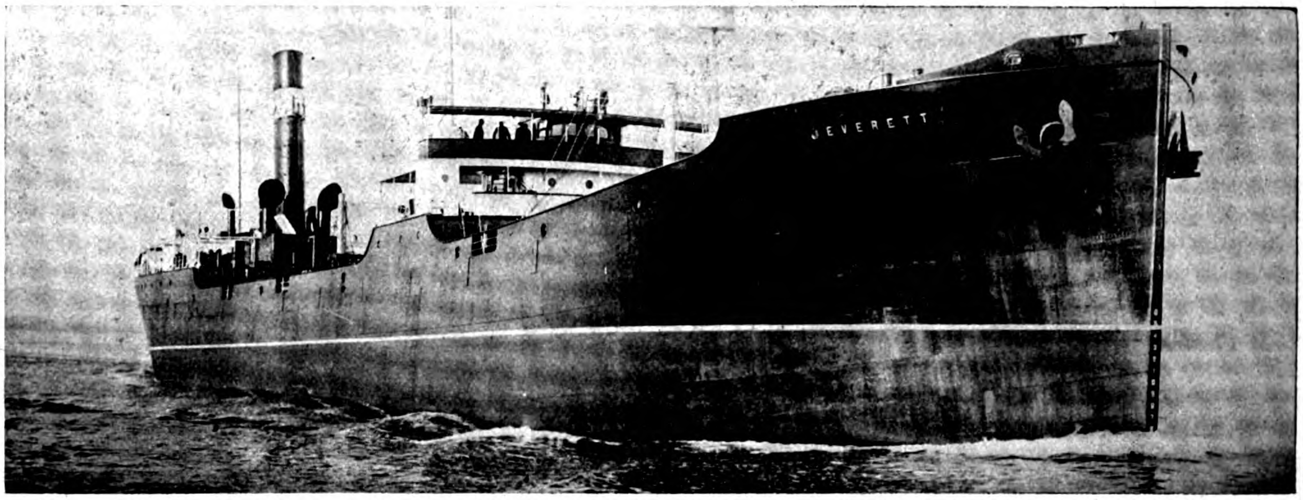

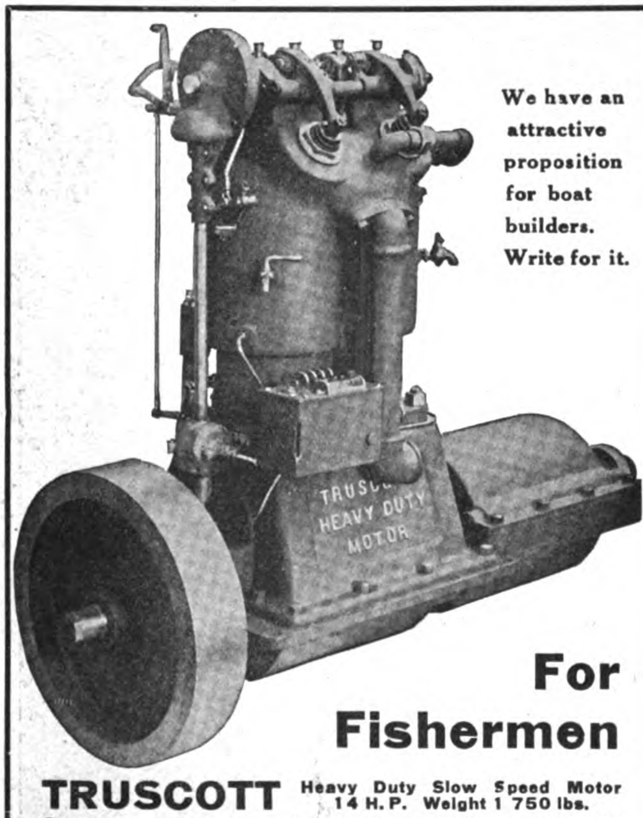

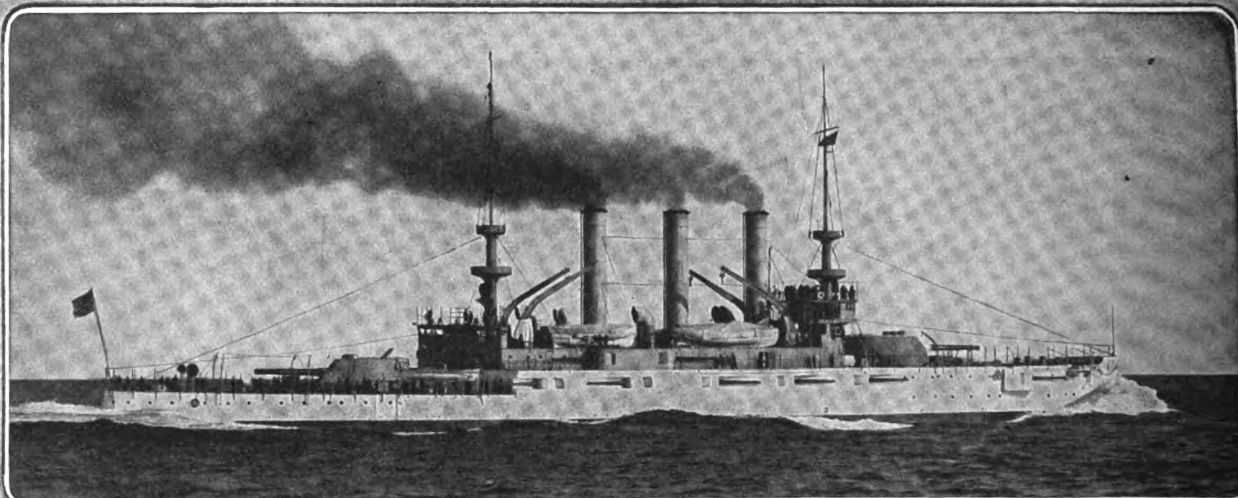

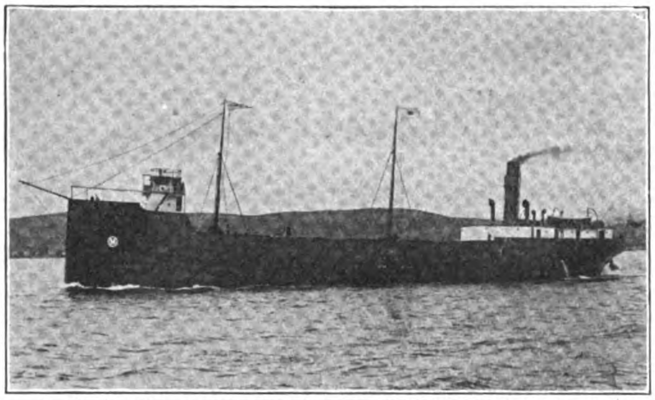

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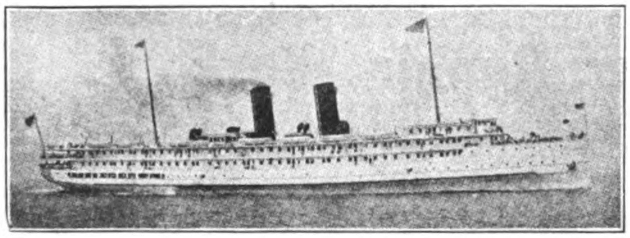

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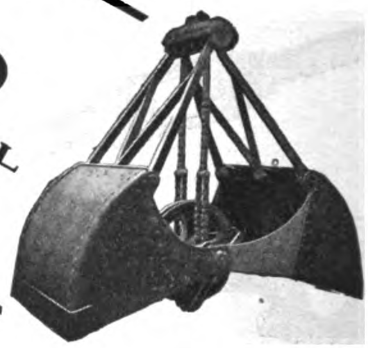

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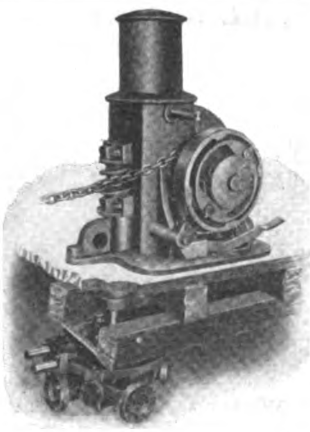

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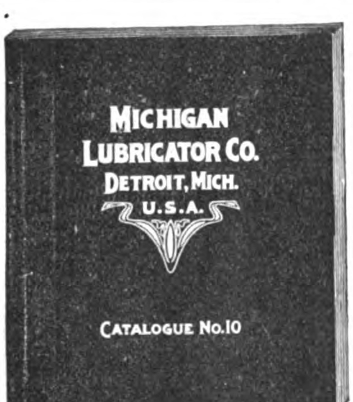

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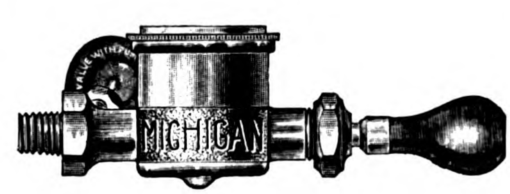

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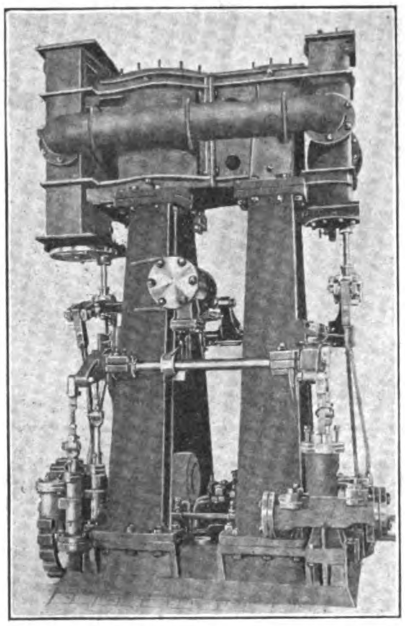

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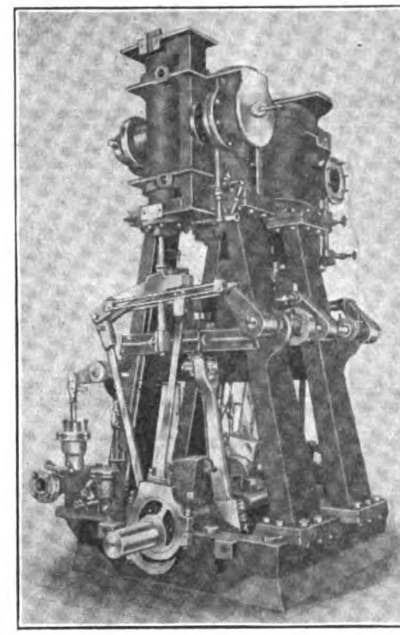

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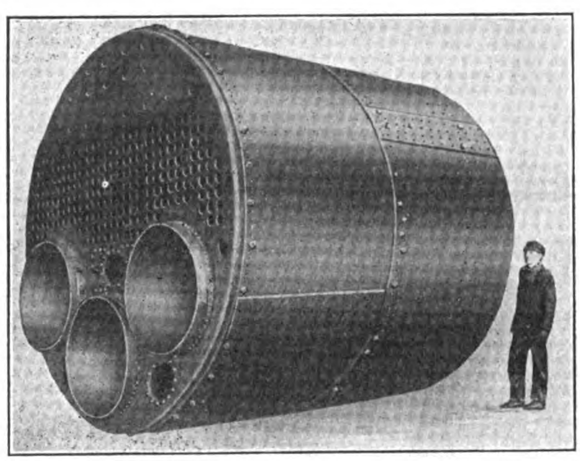

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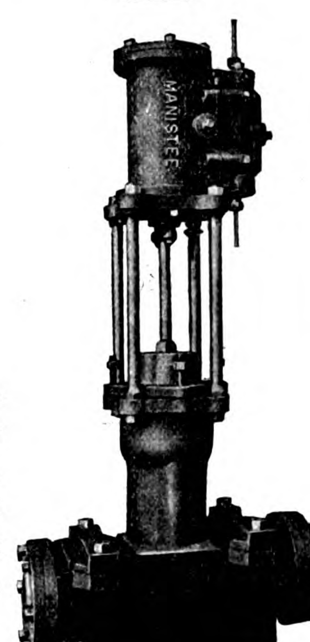

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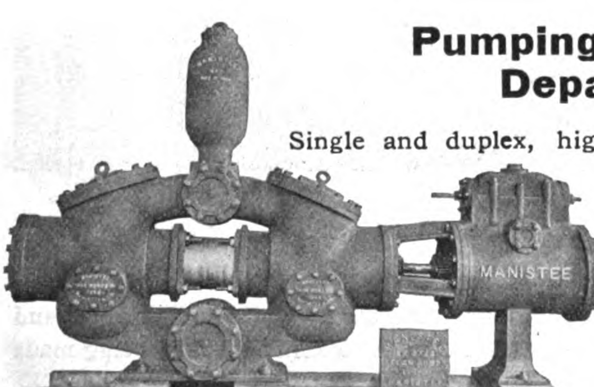

INJECTORS.

American Injector Co., Detroit, Mich.
Jenkins Bros., New York, N. Y.
Penberthy Injector Co., Detroit, Mich.

INSTRUMENTS (Nautical).

Ritchie & Sons, E. S., Brookline, Mass.

INSURANCE (Marine).

Belcher, Fred P., Winnipeg, Man.
Boland & Cornelius, Buffalo, N. Y.
Hawgood & Co., W. A., Cleveland, O.
Hutchinson & Co., Cleveland, O.
Lake Transportation Co., The, Cleveland, O.
McCarthy, T. R., Montreal, Can.
McCurdy, Geo. L., Chicago, Ill.
Mehl, Edward, Erie, Pa.
O'Connor, J. J., Port Arthur, Ont.
Parker Bros. Co., Ltd., Detroit, Mich.
Richardson, W. C., Cleveland, O.
Sullivan & Co., D., Chicago, Ill.
Vance & Joys Co., Milwaukee, Wis.
Willcox, Peck & Hughes, New York, N. Y., Cleveland, O., Chicago, Ill.

IRON.

Scully Steel & Iron Co., Chicago, Ill.

IRON (Engine Bolt).

Pittsburg Forge & Iron Co., Pittsburg, Pa.

IRON (Pig).

Hanna & Co., M. A., Cleveland, O.
Pickands, Mather & Co., Cleveland, O.

IRON (Stay Bolt).

Pittsburg Forge & Iron Co., Pittsburg, Pa.

JACKETS (Cork).

Armstrong Cork Co., Pittsburg, Pa.
Kahnweiler's Sons, David, New York, N. Y.

JOINTS (Expansion).

National Tube Co., Pittsburg, Pa.

LAMPS AND LANTERNS (Ship).

Baker & Co., Howard H., Buffalo, N. Y.
Great Lakes Supply Co., Buffalo, N. Y., and Duluth, Minn.
Upson-Walton Co., Cleveland, O.

LAMPS (Arc).

General Electric Co., Schenectady, N. Y.

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Drein, Thos., & Son Co., Wilmington, Del.
Lundin, A. P., New York, N. Y.
Truscott Boat Mfg. Co., St. Joseph, Mich.

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Cory & Son, Chas., New York, N. Y.
General Electric Co., Schenectady, N. Y.

LIGHTS (Search).

General Electric Co., Schenectady, N. Y.

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Walker & Sons, Thomas, Birmingham, Eng.

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Cook's Sons, Adam, New York, N. Y.
Michigan Lubricator Co., Detroit, Mich.
Penberthy Injector Co., Detroit, Mich.

LUMBER.

Martin-Barriss Co., Cleveland, O.

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Superior Iron Works, Superior, Wis.
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Sheriffs Mfg. Co., Milwaukee, Wis.
Superior Iron Works Co., Superior, Wis.
Toledo Ship Building Co., Toledo, O.

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Gillett & Eaton, Lake City, Minn.

MACHINERY (Wood Working).

Crescent Machine Co., Leetonia, O.

MACHINES (Towing).

American Ship Windlass Co., Providence, R. I.
Chase Machine Co., Cleveland, O.

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Chase Machine Co., Cleveland, O.
Griscom-Spencer Co., New York, N. Y.
Superior Iron Works, Superior, Wis.

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General Electric Co., Schenectady, N. Y.

MOTORS (Winch).

General Electric Co., Schenectady, N. Y.

OAKUM.

Davey, W. O., & Sons, Jersey City, N. J.
Stratford Oakum Co., Geo., Jersey City, N. J.

OILS AND LUBRICANTS.

Cook's Sons, Adam, New York, N. Y.
Dixon Crucible Co., Joseph, Jersey City, N. J.

ORE (Iron).

Hanna & Co., M. A., Cleveland, O.
Pickands, Mather & Co., Cleveland, O.

PACKING.

Home Rubber Co., Trenton, N. J.
Jenkins Bros., New York, N. Y.
Katzenstein, L., & Co., New York, N. Y.
Revere Rubber Co., Boston, Mass.

PACKING (Metallic).

Katzenstein, L., & Co., New York, N. Y.

PADDLEWHEEL RIVER BOAT MACHINERY.

Gillett & Eaton, Lake City, Minn.

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Siggers & Siggers, Washington, D. C.

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Upson-Walton Co., Cleveland, O.

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National Tube Co., Pittsburg, Pa.

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General Electric Co., Schenectady, N. Y.

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Otis Steel Co., Ltd., Cleveland, O.

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Montague Iron Works Co., Montague, Mich.

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Drein, Thos., & Son, Wilmington, Del.
Kahnweiler's, David, Sons, New York, N. Y.
Lundin, A. P., New York, N. Y.

PROJECTORS (Electric).

General Electric Co., Schenectady, N. Y.

PUMPS AND APPLIANCES (Air).

Fore River Ship Building Co., Quincy, Mass.
Great Lakes Engineering Wks., Detroit, Mich.
Kingsford Fdry. & Mch. Co., Oswego, N. Y.

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Donnelly Salvage & Wrecking Co., Ltd., Kingston, Ont.

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Roelker, H. B., New York, N. Y.

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National Tube Co., Pittsburg, Pa.

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Buffalo Dry Dock Co., Buffalo, N. Y.
Chicago Ship Building Co., So. Chicago, Ill.
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Collingwood Ship Building Co., Collingwood, Ont.
Detroit Ship Building Co., Detroit, Mich.
Empire Ship Building Co., Buffalo, N. Y.
Fore River Ship Building Co., Quincy, Mass.
Goldschmidt Thermit Co., New York, N. Y.
Great Lakes Engineering Co., Detroit, Mich.
Griscom-Spencer Co., New York, N. Y.
Johnston Bros., Ferrysburg, Mich.
Manitowoc Dry Dock Co., Manitowoc, Wis.
McIntyre & Henderson, Baltimore, Md.
Moran Co., Seattle, Wash.
Milwaukee Dry Dock Co., Milwaukee, Wis.
Newport News Ship Building & Dry Dock Co., Newport News, Va.
New York Ship Building Co., Camden, N. J.
Sheriffs Mfg. Co., Milwaukee, Wis.
Superior Ship Building Co., W. Superior, Wis.
Tietjen & Lang Dry Dock Co., Hoboken, N. J.
Toledo Ship Building Co., Toledo, O.

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Great Lakes Register Co., Cleveland, O.

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Ross Valve Mfg. Co., Troy, N. Y.

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Armstrong Cork Co., Pittsburg, Pa.
Kahnweiler's Sons, David, New York, N. Y.

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Great Lakes Engineering Wks., Detroit, Mich.
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Columbian Rope Co., Auburn, N. Y.
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Great Lakes Supply Co.,
Buffalo, N. Y., and Duluth, Minn.
Upson-Walton Co., Cleveland, O.

SAIL MAKERS.

Baker & Co., Howard H., Buffalo, N. Y.
Upson-Walton Co., Cleveland, O.

SCHOOLS (Nautical).

Chicago Nautical School, Chicago, Ill.
International Correspondence Schools,
Scranton, Pa.

SCOWS (Fueling).

Bartlett, C. O., & Snow Co., Cleveland, O.

SHAPES AND PLATES. (Ship and Boiler).

Otis Steel Co., Ltd., Cleveland, O.

SHIPS (Builders).

American Ship Building Co., Cleveland, O.
Atlantic Works, East Boston, Mass.
Buffalo Dry Dock Co., Buffalo, N. Y.
Calvin Co., Ltd., Kingston, Ont.
Clyde Ship Building & Eng'g Co.,
Port Glasgow, Scotland.
Collingwood Ship Building Co.,
Collingwood, Ont.
Chicago Ship Building Co., Chicago, Ill.
Detroit Ship Building Co., Detroit, Mich.
Empire Ship Building Co., Buffalo, N. Y.
Fletcher Co., N. & A., Hoboken, N. J.
Fore River Ship Building Co., Quincy, Mass.
Great Lakes Engineering Works, Detroit, Mich.
Johnston Bros., Ferrysburg, Mich.
Manitowoc Dry Dock Co., Manitowoc, Wis.
Milwaukee Dry Dock Co., Milwaukee, Wis.
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Newport News Ship Building Co.,
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New York Ship Building Co., Camden, N. J.
Quintard Iron Works, New York, N. Y.
Superior Ship Building Co.,
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Penberthy Injector Co., Detroit, Mich.
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Great Lakes Supply Co.,
Buffalo, N. Y., and Duluth, Minn.
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Armstrong Mfg. Co., Bridgeport, Conn.

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American Ship Windlass Co., Providence, R. I.
Underfeed Stoker Co. of America, Chicago, Ill.

STOPPERS (Chain).

American Ship Windlass Co., Providence, R. I.

SUPPLIES (Fire Department).

Morse & Son, Inc., Andrew, Boston, Mass.
Parker Bros. Co., Ltd., Detroit, Mich.
Nacey & Hynd, Cleveland, O.

SUPPLIES (Marine).

Baker, Howard H., & Co., Buffalo, N. Y.
Great Lakes Supply Co.,
Buffalo, N. Y., and Duluth, Minn.
Upson-Walton Co., Cleveland, O.

SURVEYORS (Marine).

Babcock & Penton, Cleveland, O.
Curr, Robert, Cleveland, O.
Ekstrom, G., Detroit, Mich.
Furstenau, M. C., Philadelphia, Pa.
Hunt & Co., Robt. W.,
Chicago, Ill., and New York, N. Y.
Kidd, Joseph, Duluth, Minn.
Parker Bros. Co., Ltd., Detroit, Mich.
Nacey & Hynd, Cleveland, O.
Nevins & Smith, Chicago, Ill.; Cleveland, O.
Wilby, Carlton, Detroit, Mich.
Wood, W. J., Chicago, Ill.

SWITCHBOARDS.

General Electric Co., Schenectady, N. Y.

TANKS.

Atlantic Works, The, East Boston, Mass.
National Tube Co., Pittsburg, Pa.

TESTS OF MATERIALS.

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Curr, Robert, Cleveland, O.
Ekstrom, G., Detroit, Mich.
Furstenau, M. C., Philadelphia, Pa.
Hunt, Robt. W., & Co.,
Chicago, Ill., and New York, N. Y.
Kidd, Joseph, Duluth, Minn.
Nacey & Hynd, Cleveland, O.
Nevins & Smith,
Chicago, Ill., and Cleveland, O.
Wilby, Carlton, Detroit, Mich.
Wood, W. J., Chicago, Ill.

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Goldschmidt Thermit Co., New York, N. Y.

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Montauk Fire Detecting Wire Co., New York.

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Martin-Barriss Co., Cleveland, O.

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Atlantic Works, Inc., Philadelphia, Pa.
Crescent Machine Co., Leetonia, O.

TOOLS (Wood Working).

Atlantic Works, Inc., Philadelphia, Pa.
Crescent Machine Co., Leetonia, O.

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Calvin Co., Ltd., The, Kingston, Ont.
Donnelly Salvage & Wrecking Co.,
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TRAPS (Steam).

National Tube Co., Pittsburg, Pa.

TUBES.

National Tube Co., Pittsburg, Pa.

TUBING (Seamless).

National Tube Co., Pittsburg, Pa.
Shelby Steel Tube Co., Pittsburg, Pa.

TUGS.

Calvin Co., Ltd., The, Kingston, Ont.
Donnelly Salvage & Wrecking Co., Ltd.,
Kingston, Ont.

TURNBUCKLES.

Cleveland City Forge & Iron Co., Cleveland, O

UNIONS.

National Tube Co., Pittsburg, Pa.

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Ashton Valve Co., Boston, Mass.
Jenkins Bros., New York, N. Y.
Nacey & Hynd, Cleveland, O.
National Tube Co., Pittsburg, Pa.
Penberthy Injector Co., New York, N. Y.
Ross Valve Mfg. Co., Troy, N. Y.
Scully Steel & Iron Co., Chicago, Ill.

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Ashton Valve Co., Boston, Mass.
National Tube Co., Pittsburg, Pa.
Ross Valve Mfg. Co., Troy, N. Y.

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Boland & Cornelius, Buffalo, N. Y.
McCarthy, T. R., Montreal, Can.
Mehl, Edw., Erie, Pa.
Richardson, W. C., Cleveland, O.

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Fix's, S., Sons, Cleveland, O.

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Goldschmidt Thermit Co., New York, N. Y.

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Atlantic Works, East Boston, Mass.
Case & Son, A. Wells, Highland Park, Conn.
Detroit Ship Building Co., Detroit, Mich.
Fore River Ship Building Co., Quincy, Mass.
Great Lakes Engineering Wks., Detroit, Mich.
Hyde Windlass Co., Bath, Me.
Milwaukee Dry Dock Co., Milwaukee, Wis.
Newport News Ship Building Co.,
Newport News, Va.
Roelker, H. B., New York, N. Y.
Sheriffs Mfg. Co., Milwaukee, Wis.
Superior Ship Building Co., Superior, Wis.
Thornycroft & Co., Ltd., John I.,
Southampton, England.
Toledo Ship Building Co., Toledo, O.
Trout, H. G., Buffalo, N. Y.

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American Ship Windlass Co., Providence, R. I.
American Ship Building Co., Cleveland, O.
Dake Engine Co., Grand Haven, Mich.
Hyde Windlass Co., Bath, Me.

WINCHES.

American Ship Windlass Co., Providence, R. I.
Chase Machine Co., Cleveland, O.
Hyde Windlass Co., Bath, Me.
Lidgerwood Mfg. Co., New York, N. Y.
Williamson Brothers Co., Philadelphia, Pa.

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American Steel & Wire Co.,
Chicago, Ill., and New York, N. Y.

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Montauk Fire Detecting Wire Co., New York

WOODS. (Cabin and Cabinet Finishing.)

Martin-Barriss Co., Cleveland, O.

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Calvin Co., Ltd., Kingston, Ont.
Donnelly Salvage & Wrecking Co., Ltd.,
Kingston, Ont.
Dunbar & Sullivan Dredging Co., Buffalo, N. Y.
Great Lakes Dredge & Dock Co., Chicago, Ill.
Normand & Co., Cleveland, O.
Starke, G. H., Dredge & Dock Co.,
Milwaukee, Wis.
Sullivan, M., Buffalo, N. Y.

WRECKING AND SALVAGE COMPANIES.

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Donnelly Salvage & Wrecking Co.,
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Normand & Co., Cleveland, O.
Parker Bros. Co., Ltd., Detroit, Mich.

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Atlantic Works, East Boston, Mass.
Drein, Thos., & Son, Wilmington, Del.
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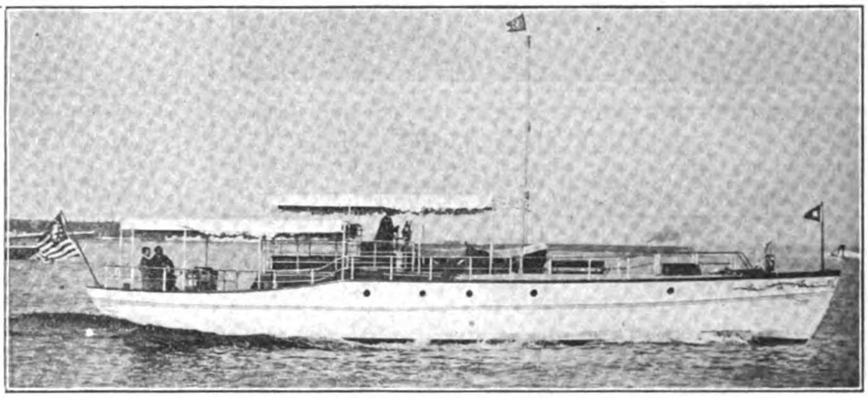

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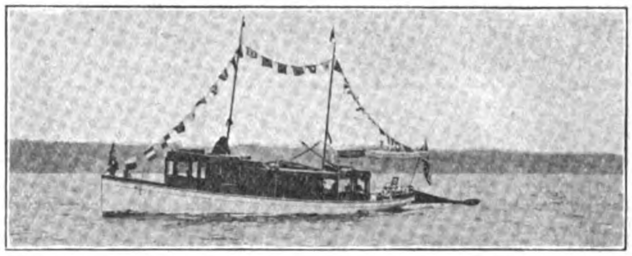

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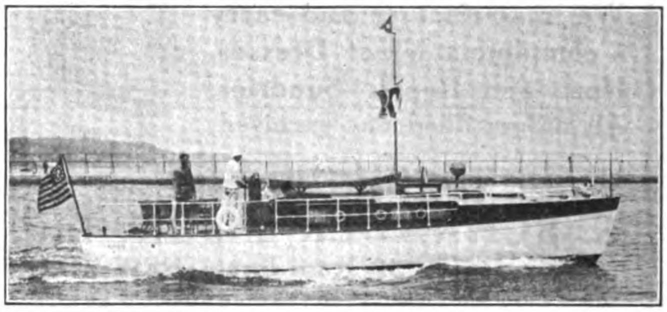

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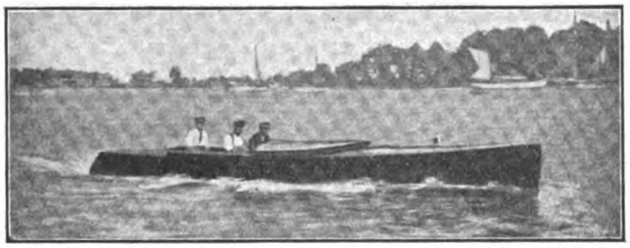

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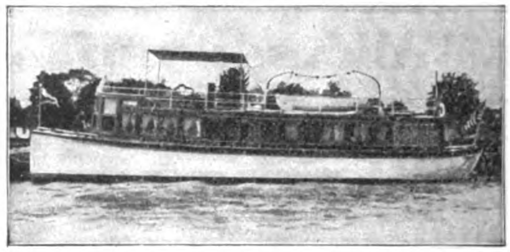

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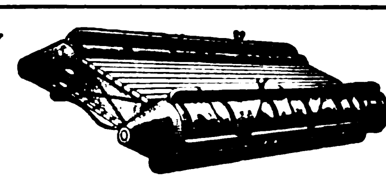

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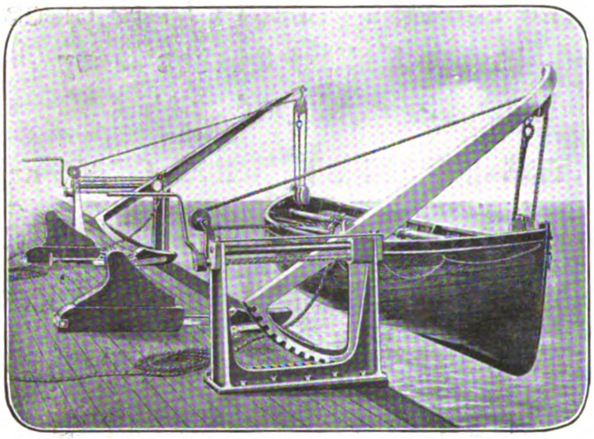

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